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MANUAL
OF
INJURIOUS INSECTS
AND
METHODS OF PREVENTION

E.A. ORMEROD

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MANUAL OF INJURIOUS INSECTS

AND

METHODS OF PREVENTION.

"It cannot be expected that success will at once attend our efforts; but it may be hoped that the data once ascertained, and facts correctly recorded, good results will soon follow, from the dissemination of sound practical knowledge." —JOHN CURTIS, *in Introduction to 'Farm Insects.'*

"Those candidates who had been engaged in the practical work of the farm were free from the hesitation and uncertainty which some of the more theoretical students displayed."—*Observation in Report of Examiner in Agriculture of the Royal Agricultural Society of England, May, 1890.*

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Eleanor A. Emerod.

A MANUAL

OF

INJURIOUS INSECTS

WITH METHODS OF

PREVENTION AND REMEDY

FOR THEIR ATTACKS TO

FOOD CROPS, FOREST TREES, AND FRUIT.

TO WHICH IS APPENDED A

Short Introduction to Entomology.

COMPILED BY

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ALSO

MEMBER OF THE ASSOCIATION OF OFFICIAL ECONOMIC ENTOMOLOGISTS, WASHINGTON, U.S.A., &C.

SECOND EDITION.

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1890.

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TO

ALL WHO ARE INTERESTED

IN THE WORK OF

SAVING FOOD OR TIMBER OR FRUIT CROPS FROM INSECT RAVAGE;

TO

THE MANY FRIENDS,

BOTH IN MY OWN COUNTRY AND IN OTHER PARTS OF THE WORLD,
TO WHOSE KIND HELP AND ENCOURAGEMENT I HAVE
BEEN INDEBTED FOR MANY YEARS;

AND ALSO TO THE

MEMORY OF THOSE AMONG THEM WHO ARE NO LONGER WITH US:

This Work

IS GRATEFULLY AND RESPECTFULLY INSCRIBED BY

THE WRITER.

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INTRODUCTORY PREFACE.

The object of the present volume, of which the First Edition was published in 1881, is to give, in short and plain form, some account of the insects that are commonly injurious to our food crops, forest trees, and fruit, together with methods of treatment that have been found serviceable in preventing attacks, or in averting serious damage.

Since the above date much has been learnt in this country regarding available measures, both for preventing increase of insect pests, and also for lessening the amount of loss caused by their ravages when present. Also (and mainly from the observations of our own agriculturists), the appearances have been recorded of various kinds of crop pests which had previously not been observed as present in this country, or as not being present to an injurious extent; and many points have been brought to light, in the history of those previously known, on which information was needed in order to enable us to counteract their ravages.

In the present volume I have endeavoured to add the main points of the above observations to those originally given, and with them the results of much technical consultation and co-operation, both as to identification and habits of insects, with which I have been favoured by Entomologists of our own and other countries.

Amongst attacks of crop pests which have been recorded as first observed here during the past few years, is notably that of the Hessian Fly (*Cecidomyia destructor*), first recorded here in 1886; the Stem Eelworm (*Tylenchus devastatrix*) has still more recently been proved to be the cause of the diseased growths known as Tulip-root in Oats and as Stem-

sickness in Clover; and the attacks of the Frit Fly (*Oscinis frit*)—a pest little known here before—to Oats in 1888, and the yearly recurring damage from Wheat-bulb Fly (*Hylemyia coarctata*) to young Wheat plants, have also been brought forward.

Notes of a few kinds of crop attacks mentioned in the First Edition which have proved to be of little practical importance are now omitted, and, instead, observations have been added of the above-named infestations, and about eighteen other kinds of attack injurious to a serious extent to farm or fruit crops, or in a few instances to timber plantations.

It will be seen that the special subjects of Wireworm, Turnip Flea Beetle, Mustard Beetle, and Hop Aphis are entered on at length, from the observations with which I was favoured for publication in my special reports on these subjects; and throughout the book I have endeavoured, as far as possible, to complete the life-histories of the insects from British observations placed in my hands, and also to replace notes of preventive treatment which have become out of date, or not found to answer with certainty, by observations of measures which have more recently been brought under notice and found repeatedly to be of service.

In this matter the chemical manures now available, which are highly beneficial as plant-stimulants (but by no means so to vegetable-feeding grubs and maggots), and the many kinds of agricultural implements by which the soil can be more completely broken up on the surface, or the surface more thoroughly buried down than was formerly the case, are of great assistance to us.

The different kinds of attack are, for the most part, arranged alphabetically under the headings of Food Crops, Forest Trees, and Fruit, beginning respectively with Asparagus, Ash, and Apple; and the insects attacking each crop or tree are also, so far as could be managed, similarly arranged alphabetically under such crop, by the name by which they are *commonly* known, as Turnip "Fly" or Flea Beetle, Wireworm, &c.

A work of this kind, involving measures of treatment of the most varied nature, must necessarily be a compilation from many sources, and the special contributions of information I

have carefully acknowledged throughout, but with some difference in method. In the observations continued from the First Edition the initials of the contributors are, as before, appended, the names and addresses being given in the list at pp. 399, 400. Again I have to express my thanks to Mr. Malcolm Dunn, of Dalkeith, who aided me in forming the plan of the original volume, and with introductions especially to Scottish Head Foresters, and Superintendent Gardeners, by which I obtained much valuable information; and I am also much indebted to Mr. George Brown, of Watten Mains, Caithness, N.B., for consultation and information as to agricultural points, given me for the First Edition.

In the case of the observations added in the present Edition, I have (as in my Annual Reports) appended the name and address of the observer to the information given.

To all I beg to express my hearty thanks for their courtesy, and for the kind as well as skilled aid afforded me in the work, now for more than thirteen years, which aid has enabled me to lay before my readers the views of many whose names alone are enough to tell the value of their recommendations regarding the best methods of dealing with some of our worst crop pests.

In the entomological part I acknowledge, with many thanks, assistance, both personal and by his works, from my much-valued friend, Prof. J. O. Westwood, Life-President of the Entomological Society of London; and also, in the difficult task of identification of the Diptera, from Mr. R. H. Meade, of Bradford.

I am also greatly indebted for kind assistance in my work to the official Entomologists of other countries, and, amongst these, for the cordial help always given me by Mr. J. Fletcher, Dominion Entomologist of Canada, and likewise by Mr. Frazer S. Crawford, Inspector under the Vine, &c., Protection Act in South Australia. I should also acknowledge my obligations to Prof. C. V. Riley, Entomologist of the Department of Agriculture of the United States of America; to Dr. J. A. Lintner, State Entomologist of New York State; and likewise to Dr. J. Ritzema Bos, Prof. at the State Agricultural College, Wageningen, Holland, for the valuable co-operation kindly accorded

me, now for some years, in identification and observation of our crop Eelworms, a branch of research which cannot be carried out trustworthily save under the guidance of an expert in this difficult study.

I must also add to the names of those to whom I am especially indebted that of my sister, Miss G. E. Ormerod, as my constant colleague, and my unfailing and skilled helper, in all my work; and I should fail in what is a duty as well as a pleasure if I did not mention, with many thanks, the encouragement and help ever heartily and courteously accorded to me by our agricultural, and often by our general, press.

With regard to information taken from published sources, I trust it will be found that this has always been fully acknowledged. In the case of the descriptions of some of the commoner insects, where I have not named (as in my First Edition) any special authority, I have omitted this, partly because these are so often taken from collation of accounts to be found in all the monographs and entomological works that deal with these subjects, that it is impossible to name one of these more than another; and also because, in the long series of years in which I have worked on Agricultural Entomology, I have had such frequent opportunities of examining crop insects in their different stages, and under different circumstances of feeding, that I have become personally acquainted, from life, with much of what, at first, I thought it right to give the abstract of information in quotation.

With regard to assistance given me, by use, purchased or otherwise, of figures, it appears to me that all work beyond that of the author of the book should be specifically acknowledged; and therefore, although I am aware that the following arrangement is not the custom here, I have followed the example set in publications of similar nature to my own by leading official Entomologists of Canada and the U.S.A.; and I trust that I may be found to have *honestly* acknowledged the aid *courteously* accorded. The number of figures given in this Edition have been much added to, and in some cases re-drawn; and I acknowledge the following, with many thanks, as from the sources named below.

A large number, which I am permitted to use by the

courtesy of Messrs. Blackie and Son, Stanhope Street, Glasgow, which are mainly from the pencil of the well-known John Curtis, will be found at pp. 3, 5, 11, 14, 16, 18, 23, 24, 25, 29, 31, 35, 39, 45, 48, 55, 62, 65, 73, 76, 90, 94, 97, 110, 126, 130, 133, 134, 148, 151, 156 (2), 163, 164, 171, 174, 177, 180, 192, 195, 199, 201, 365, 381, 383, 385, 386, 393.

Figures used, by permission of the proprietors of the 'Gardeners' Chronicle,' in the First Edition, are now again repeated at pp. 142, 162, 242, 247, 256, 260, 292, 295, 300, 310, 324, 361.

Figures of moths (and, at p. 265, of a caterpillar) from Newman's 'British Moths,' are given, by permission of Messrs. W. H. Allen and Co., at pp. 9, 58, 232, 265 (2), 290, 311, 320, 322, 335, 336, 338, 390 (2).

I also acknowledge, with thanks, figures at pp. 144, 196, 212, 214, 237, and 308, of which I am permitted the use by Mr. T. P. Newman; also figures of caterpillars at pp. 290, 322, 386, and of wingless moth at 338, after Dr. E. L. Taschenberg. Also figures of Aphides, at pp. 119 and 280, after drawings by Mr. G. B. Buckton, F.R.S.; and figures of Eel-worms, at pp. 51 and 53, respectively after drawings by Dr. J. Ritzema Bos and Dr. Charlton Bastian.

Figures at pp. 286 and 313 are respectively from one of Prof. W. Saunders, and one in the Trans. of the Ent. Soc. of Canada.

Figure at p. 383, by Prof. C. V. Riley, and also at pp. 81 and 392, from 'Reports of Department of Agriculture,' U.S.A.; likewise figure at p. 84, after Prof. Webster.

Also figure at p. 338, after Prof. J. O. Westwood; and at p. 385, after figure in Stephens' 'Illus. of British Entomology.'

Besides the above, are figs. at pp. 1, 33, 77, 78, 80, 82, 83, 92, 99, 106, 127, 129, 140, 144, 157, 169, 172, 209, 216, 220, 227, 229, 233, 235, 238, 243, 250, 258, 260, 267, 271 (2), 281, 286, 297, 303, 306, 318, 330, 376, 382, 393, 395 (2), drawn partly by myself, but for the most part by Mr. Horace Knight, artist to Messrs. West, Newman & Co., 54, Hatton Garden.

The portrait which has been prefixed to the work, by desire of friends, is from a photo by Messrs. Byrne & Co., Richmond, Surrey, the reproduction being printed for me by permission of

the proprietor of the 'Farmers' Magazine,' 145, Queen Victoria Street, E.C., and under his direction.

In submitting this work in its enlarged form (as before, with the First Edition), I cannot but feel uneasiness as to how far my own part of the compilation may meet the approval of those better able than myself to judge on many of the points entered on. But so far as in me lies, I have tried, by careful revision, and collation of authorities, and all other means in my power, to render the technical portions of the volume, bearing on insect descriptions and life-histories, free from inaccuracies, and to bring them up to the present date.

Of the portion, representing the greater part of the work, which deals with remedial and preventive measures, I may say, in the spirit and almost in the words, of my late valued friend, Mr. Chalmers Morton, in the Preface to his 'Cyclopædia of Agriculture,' that this "is written by such a large number of gentlemen practically conversant with the subjects which they severally describe," that I fully trust it may often be found of service in lessening the losses which at present (and often solely for want of having a little plain information at hand) add greatly to the burdens which weigh down agricultural prosperity.

To all who have aided me I offer my sincere thanks; and so long as it may be desired, and health and power are granted me, I trust to labour to the best of my ability in the cause of Injurious Insect prevention.

ELEANOR A. ORMEROD.

Torrington House, St. Albans,
August, 1890.

PART I.

FOOD CROPS

AND

INSECTS THAT INJURE THEM.

PART I.

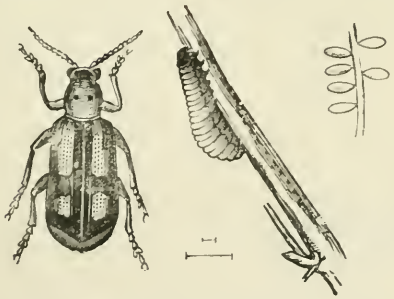
FOOD CROPS

AND

INSECTS THAT INJURE THEM.

ASPARAGUS.

Asparagus Beetle. *Crioceris asparagi*, Linn.



Asparagus Beetle, larva and eggs; all magnified. Natural length of egg and beetle shown by lines.

The Asparagus Beetle often causes injury, and in some seasons does much damage, by the grub eating off the leaves of the Asparagus, and gnawing the more t .s to destroy them.

The eggs are dark-coloured, somewhat sp .ed, and may be readily observed fastened by one end .. the shoots, or on the unopened flower-buds.

The grubs are of a dirty olive, or slate-colour, and exude a large drop of blackish fluid from the mouth on being touched. From the tail being curved and holding fast by a fleshy foot, it is very difficult to pick them off. They are full-fed in a fortnight, when they go down into the ground, spin parchment-like cocoons, in which they change, and come up as perfect beetles in about another fortnight or three weeks.

The beetles are about a quarter of an inch long, blue-black or greenish; the body behind the head red, with two black spots. The wing-cases are ochreous-yellow, with a line down the centre of the back, a branch from each side of it, and also a spot or patch at the base and tip of each wing-case of blue-black. These markings form a kind of cross, whence the name sometimes given of "Cross-bearer."

The successive broods of Beetles lay their eggs directly after development, and the insect, in all stages, may be found from about the middle of June till the end of September.

The 12-spotted Asparagus Beetle, which differs from the above in being red, with twelve spots on the wing-cases, is seldom found in England.

Prevention and Remedies.—Dipping the infested shoots in a mixture of half a pound of soft-soap, a quarter of a pound of flower of sulphur, and about the same quantity of soot, well mixed together in a pail of warm water, has been found a good remedy. The infested shoots were well dipped, and next day the grubs were found to have all been cleared off. The plants were afterwards syringed, to clean off the dirt left by the dipping, and soon regained their healthy appearance. —(W. D. C.)

Syringing with water warm enough to make the grubs loosen hold, but yet not of a heat to hurt the leafage, clears them off well. The greater part of the grubs fall as the water touches them, and the rest on a smart tap being given to the shoot. Dry soot plentifully thrown on to them, whilst they are on the ground under the Asparagus and are still wet, appears quite to prevent any return of the grubs to the shoot. If any (either of the beetles or grubs) return, a repetition of the treatment would probably clear them completely.

A large number of beds may soon be dressed by a man and boy going round together—one syringing, the other striking the shoots and throwing the soot upon the grubs; and the growth of the Asparagus, after this slight manuring, is good. The water should not be of a heat above what can be well borne by the hand.

Hand-picking has been recommended, but from the strong hold that the grub has on the shoot this is difficult to manage without hurting the plant; but a little salt (or any other application disagreeable to the grub) taken in the fingers, instead of working bare-handed, helps to make it loosen its hold.

Cutting off the shoots that are badly infested with eggs and burning them is of service.

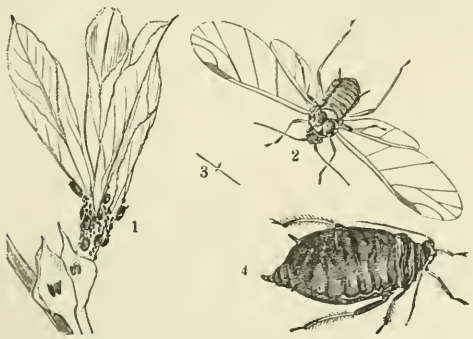
Shaking the beetles into a wide bason or tray, held below

to receive them, has been recommended; but it is desirable that some mixture of mud or soot and water or smearing of tar, which would almost certainly act well in retaining them, should be provided for them to fall into, or they would soon escape.

Strewing the plants well with unslaked lime early in the morning, whilst the dew is still on, is also recommended.

BEAN.

Bean Aphis. *Aphis rumicis*, Linn.; *A. fabæ*, Kirby & Spence.



1, Bean-shoot, with Aphides; 2, male Bean-Aphis, magnified; 3, nat. size; 4, wingless female, magnified.

The Bean Aphis (known also as "Black Fly," "Collier," and "Black Dolphin") sometimes appears in such vast numbers as to smother the Beans, making them look as if they were coated with soot. The attacks are begun by a few wingless females establishing themselves near the top of the Bean-shoots, where they produce living young. These in their turn are soon able to produce another living generation; and so on, and on, till the increase is enormous, and from the numbers of the "Black Fly," and the sticky juices flowing from the punctures which they have made with their suckers, the plant becomes a mere dirty infested mass, with a few diseased leaves sticking out from amongst the plant-lice.

These Aphides are very similar in shape throughout all their stages, excepting that in the first and second (which

answer to those of larva and pupa), although they have six legs and are active, they have not wings.

The young are slaty grey, but soon acquire a blackish velvety coat. The pupa is larger and slaty grey, excepting the abdomen, which is black with various white spots, and the wing-cases are also black.

Of the two kinds of females producing living young, the wingless kind is shiny (or sometimes dull) black; eyes and cornicles black; shanks and the middle joints of the horns are somewhat ochreous. The head, body, and abdomen are so much grown together as to seem almost like one piece (see fig. 4, magnified).

The winged female is shiny and black, or with a brownish tinge; the shanks and middle joints of the horns are amber-yellow, and the wings are yellow at the base, with a green line and mark on the fore edge, and brown veins.

The egg-laying female—that is, a third description, which appears in autumn, and lays the eggs from which a new series of generations, producing living young, will start again in the following year—is very like the wingless viviparous form figured above. The male (fig. 2, magnified) is black and winged.—('Farm Insects,' by John Curtis, and 'Mon. of Brit. Aphides,' by G. B. Buckton, F.R.S.).

Prevention and Remedies.—No better plan appears to be known than cutting off the infested tops of the Beans, but it should be done as soon as the "Colliers" are noticed. This point is very important, on account of the extraordinary rate at which Aphides increase. The tops should be trampled on thoroughly as they are cut off; or sheared into baskets and burnt; or destroyed in some way before the Aphides can leave them, for if these are left amongst the Beans the insects are able to make their way back again to the growing plants, and thus little good will have been done.

In garden cultivation, where there is only a small amount of crop to be attended to, it sometimes answers to throw soot on the infested plants. This lodges well amongst the Aphides and in the axils of the leaves. Any dry dressing that would thus lodge, and make the Bean-tops more or less unpalatable to the Aphides, would be of use. Where only a small extent of crop needs attention, a good drenching with strong soapsuds, or syringing with a solution of soft-soap, would also be useful; the soapy matter sticks to the Aphis, and is thus a much surer remedy than many of the attempted applications which run off at once from the skin of the insects, and consequently are useless.

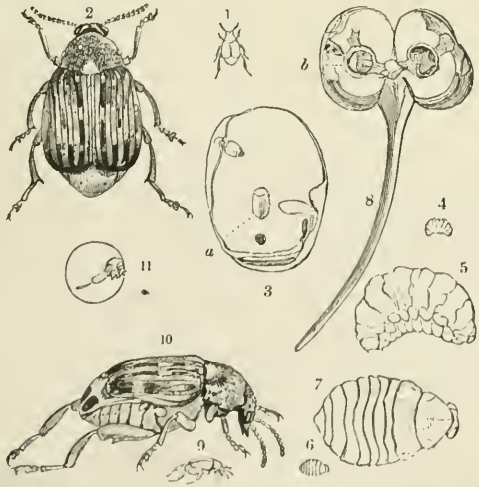
Probably the addition of a very small quantity of paraffin,

or other mineral oil, to the soft-soap wash would make the application much more serviceable. For proportions that may be safely used and method of preparation, see references to "paraffin" and "emulsion" in Index.

A healthy, luxuriant growth is also of importance. The "Colliers" may attack the healthy as well as the unhealthy plants, but the strong growth which is run on by previous good cultivation of the ground, and also the application of a little liquid manure if desirable, will keep the plant in heart with a plentiful flow of sap, and thus it will suffer much less from attack than the weakly, stunted growths that have no power to replace the juices which the Aphides are constantly sucking out of them.

Removal of the wild plants on which this kind of Aphis is to be found would probably materially lessen its numbers. These "Colliers" or "Black Flies" are to be found in great numbers on the Curled Dock (*Rumex crispus*, whence their name of "*rumicis*"), and also on Thistles; and it is stated (see 'Brit. Aphides,' vol. ii. p. 83) that the wingless egg-producing female winters in Furze-bushes, the branches of which may be found dotted with Aphis eggs.

Bean Beetle. *Bruchus granarius*, Curtis; *B. rufimanus*, Boh.



1 and 2, *Bruchus rufimanus*, nat. size and mag.; 3, infested Bean split open, showing cell; 4 and 5, larvæ, nat. size and mag.; 6 and 7, pupæ, nat. size and mag.; 8, Bean injured by beetle, vegetating; 9 and 10, *Bruchus pisi*, nat. size and mag.; 11, injured Pea.

The mischief caused by this beetle is from the maggots feeding in the seeds of various kinds of Broad or Tick Beans, and thus lessening their value by weight for sale, and also their value for seed, as, where much is eaten away, the growing power of the young plant from the damaged seed is also lessened.

The maggots are fleshy, wrinkled across, and with a small horny, rusty-coloured head. As far as I am aware, they are legless, but in some kinds of Bruchi there are the rudiments of feet on the front segments.

The method of attack is for the Bean-seed Beetle to lay its egg on the young seed-vessel in the Bean-blossom before this is large enough to be called a pod, and from these eggs the maggots hatch, which presently pierce into the growing Beans. Then each maggot gnaws a gallery for itself, and there, amongst the dust and dirt (consequent on results of its feeding) which remain in the closed-up tunnel, it turns to the chrysalis, and thence to the beetle state.

The beetle is little more than the eighth of an inch long, and if looked at under a magnifying glass will be found to have the head drooping, with the mouth forming a kind of wedge-shaped beak, the fore part of the body somewhat bell-shaped, and each wing-case pitted with ten rows of small dots. The colour is black, with brown hairs and various white spots; the tip of the tail prolonged, and covered with grey down. The front pair of legs are reddish. The beetles may be found on flowers of the Furze as early as February, but though they may be found in seed Beans in March, April, and May, they do not always leave the seed as soon as they are developed.

Beans that are still infested by the beetle may be known by having a little round depression in the skin, which is also, at this spot, slightly yellowish or transparent. This appearance is caused by the substance of the Bean having been eaten away inside by the maggot, which gnaws its gallery in the seed up to the skin, so that this sinks a little into the hollow space. When the beetle emerges, it pushes this circular bit of skin off, and the round holes thus caused show that the seed *has been* infested. Autumn-sown seed is most likely to be infested, as a large proportion of the beetles do not come out till the end of winter, or, in some cases, well on in spring.

Prevention and Remedies.—A great deal may be done towards preventing future attack, and loss consequent on weakened plant growth from damaged seed, by ascertaining what the condition of the seed is before purchase, or before sowing. When the beetles have left the seed, the round hole

through which they escaped will show where they have been, and such seed is to be avoided. The injured seed will sprout in most cases, but although the growing germ is left, a great part of what this germ needs to make it grow healthily is gone. If we consider that, in germination, chemical changes take place by which the insoluble starch in these seeds is turned into soluble plant-food, and that on this alone the young sprouting plant is nourished until the leaves and rootlets are produced, it will be evident that our chances of a strong and healthy plant are much diminished by using maggot-eaten seed. The young plant depends on the quantity of food in the seed for the vigour of its first start, and if this first start is not vigorous the later growth will probably be stunted and sickly also; therefore seed with a large proportion of "holed" beans is not desirable for sowing.

Where, instead of a round hole about as large as a shot-hole, there is a round depression, as mentioned above, rather duller in colour, and rather more transparent than the part around, this shows that the Bean is still infested; and if the small round piece of skin is lifted off, the beetle will probably be found within. Such seed should not be sown. If Beans or Peas thus infested are sown (without some dressing being applied or measures taken to kill the insects within), the beetles will not be injured by being buried, but will come up through the ground in due time to infest the new crop.

The following note of successful use of blue vitriol, together with McDougall's sewage carbolic and amount applied, was placed in my hands by Mr. Geo. Street, of Maulden, near Ampthill. On 10th of May, 1888, Mr. Street wrote me that the dressed Beans had made excellent progress, and the result as far as he could see was perfectly satisfactory. "The dressing applied to the Beans was used in a similar way to that used for seed-wheat. Formerly we used 'blue vitriol' only, but the addition of McDougall's sewage carbolic leaves a smell, which to some extent prevents birds eating the seed-corn. I am inclined to think the carbolic alone would be sufficient, if a larger quantity was used. We used 6 bushels of Beans, 6 quarts of water, 1 lb. of 'blue vitriol,' and 1 pint of sewage carbolic. I am inclined to think that Beans should be dressed some few days before they are sown, (as the skin is thick), and turned over with a shovel every day. Those which escaped the liquid dressing might be killed by the strong dust which would be formed when the Beans were again dry."

Good results have been found from the use of Calvert's carbolic acid, at a strength which killed all the insects in the Beans without hurting the seed.

In my own experiments on infested Beans, I found that if

placed for a short time to soak, the water passed through the thin film of coating of the Bean at the end of the gallery, and soddened the powdery dust and rubbish within, and thus choked the breathing-pores of the beetle lying within, and killed it; but it is open to doubt whether, if weather was unfavourable for sowing when the Beans had been wetted, they might not be harmed.

The following observations by Mr. J. Fletcher, the Dominion Entomologist of Canada, refer to methods which have been found serviceable for preventing weevil attack to Peas or Beans:—"When the supply of seed on hand will permit it, it is better to keep the Beans over until the following year in some close vessel. The beetles will emerge the first spring, and die without injuring the Beans further. A similar plan is that practised with the Pea Weevil, of keeping the seed Peas shut up in a close vessel in a warm room during the winter, when the weevils will emerge and die long before the seed is wanted for sowing. The remarkable freedom of Peas in Canada from the attacks of the Pea Weevil, during the last few years, is attributed by some to the care taken by seed merchants to poison all weevils contained in seed Peas, by subjecting them for some time, in large closed receptacles, to the poisonous fumes of bisulphide of carbon."*

In some years *Bruchus* attack does a deal of mischief. In 1888 Mr. E. A. Fitch, of Maldon, Essex, reported to me that in his "own case a most moderate computation of loss of weight alone of 2*s*. per quarter would give £65 12*s*., *i. e.*, 164 acres×4 quarters the acre×2*s*. per quarter."

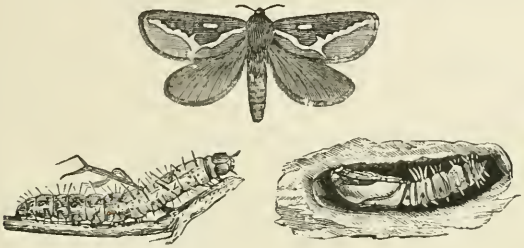
Bean Beetles (*Bruchi*) of various species are found—sometimes in enormous quantities—in imported seed, and where there is much Bean-growing round mills where Beans are ground, it would be highly desirable some measures should be taken to save us from the consequences of the vast numbers sometimes to be found in such places.

Dipping the Beans or Peas in boiling water for one minute is stated to kill the grub inside without hurting the seed, but as dipping for four minutes generally destroyed the germinating power the experiment is much too hazardous for general use as regards seed, though it might be acted on with advantage with regard to Beans or Peas about to be ground. For farm use, however, the main point is to avoid purchase of infested seed; or if none but infested seed is available, in such case to dress it before sowing; and also as the harm done to the seed takes effect in weakening the young plant in

* See "Report of Entomologist and Botanist" p. 56; in 'Appendix to the Report of the Minister of Agriculture on Experimental Farms' (Her Majesty's Printers, Ottawa, Canada 1889).

its earliest growth, to counteract this as far as possible by plentiful manuring, and such cultivation of the land as will put good supplies of food in reach of the young rootlets directly they are able to absorb it.

"Small" or "Garden" Swift Moth. *Hepialus lupulinus*, Linn.



Hepialus lupulinus:* moth, caterpillar, and chrysalis.

The caterpillars of the Garden Swift Moth are recorded as living on the roots of a large variety of plants, amongst garden crops, on Parsnip, Lettuce, Potato, Celery, and Strawberry plants, also on grass-roots; and, with regard to their powers, it is mentioned, "their destructive habits are scarcely to be equalled by the 'Surface-grubs.'" They are to be found in autumn and winter, as well as spring, and are stated to turn to chrysalids in May, from which the moths come out in about a month.

So far as my own observations go, I have only once received communication of a really serious attack attributable to this caterpillar; but as there appears to be reason to think that a good deal of mischief, of which the precise authorship has not been traced, may be owing to these caterpillars working on various kinds of plants just below the surface in the spring time, I append the full description; as given by John Curtis in his paper on this subject in the 'Gardeners' Chronicle':—

"The caterpillars are cylindrical, yellowish white, the head is brown and horny, with two minute antennæ; the 1st thoracic segment is horny and pale brown; the following segments have four dark dots on the back of each, producing bristles, with a greyish intestinal line between them often blackish at the tail; there is a similar line of dots and hairs down each side, and beneath them the black spiracles, which are bristly. They have six pectoral, eight abdominal, and

* The worst attack of the above caterpillar that I have report of was to Bean crop; therefore I have placed it under this heading.—E. A. O.

two anal feet. They changed to a very sensitive, cylindrical pupa, ochreous and shining."*

The figures of the caterpillar and chrysalis are partially taken from those given by Curtis in the paper quoted, and it will be observed that the chrysalis shows the shape of the forming moth within it, and that the position of the wings and legs are clearly discernible.

The figure of the moth shows its shape, and the usual pattern of the white markings, but the colour is excessively variable. It may be generally described as having the fore wings clay-colour or brown, with various white stripes and dots, and the hinder wings of a brown or smoky brown. Sometimes the markings on the fore wings scarcely show, and the moth then is of a dirty pale brownish colour. The size also varies from an inch to an inch and a half in spread of the fore wings. The female moth is sometimes considerably larger than the male. As the names differ as much as the varieties, I have taken Professor Westwood's name of the "Small Swift," which distinguishes it well from the much larger kind (the "Ghost Moth" or "Hop Swift"), the caterpillar of which specially attacks Hop-roots. The name of "Swift" is given on account of the rapidity of the flight. The moths may be seen in the evening by hedgerows or grassy banks, over grass, where they drop their eggs in large numbers.

In the spring of 1885 I received specimens corresponding with the caterpillars of this moth, from Mr. Martin Burl, of Elsenham, near Bishop's Stortford, with the observation that they were samples of earth grubs which were destroying his winter Beans, gnawing the stalks in two a little below the ground. They were a strong healthy plant, sown early in October, ploughed in and pressed with ribbed roller in strong clay-land after wheat, and he feared that about two acres of the twenty were hopelessly ruined.

With regard to getting rid of this special attack, Mr. Burl noticed, on March 10th, that in digging them that morning (being frosty) he found some of them retired quite into the solid ground, in a cavity just fitting them; and consequently he was going to cultivate as deeply as possible between the rows of Beans, in hopes of turning out a good many of the pests.

This plan might be expected to act well wherever the grubs could be reached, as they were obviously sensitive of weather influences; and turning them out of their self-made shelters would act as thoroughly on them as on the common surface

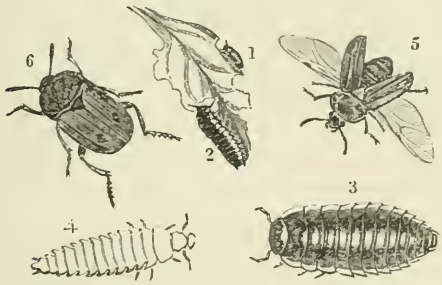
* 'Gardeners' Chronicle' for 1845, p. 873.

caterpillars, which are best cleared out of infested land by throwing them out to alternate wet and cold.

No special means of getting rid of this attack appear to have been recorded, but the measures of treatment suitable for clearing "Surface-caterpillars" (see Index) would be applicable to these grubs also.

BEET.

Beet Carrion Beetle. *Silpha opaca*, Linn.



1 and 2, young and full-grown larvæ; 3 and 4, larvæ magnified; 5, female beetle flying; 6, male beetle, slightly magnified.

The Beet Carrion Beetle is very common, and is often to be found in small carcases, as dead birds, rabbits, garbage, &c.; and until rather more than forty years ago it does not appear to have been known that its maggot was at times a vegetable feeder. About that date it was first observed as feeding on Beet-leaves in France, and from this circumstance—namely its double method of feeding—it takes its common name of the Beet Carrion Beetle. Since then it has been recorded as doing harm to Mangolds in Ireland, and in 1884 specimens were sent to me from Mageny, Co. Clare, of this beetle, which was then eating away the Mangold-leaves down to the stems.

Up to 1888, however (though the beetle is common here), we have no records, as far as I know, of either this Beet Carrion Beetle or its maggot being a crop-pest in England.

I had then observations of the presence of this attack sent me, with specimens accompanying, from Ruyton Towers, near Shrewsbury, where they were reported as having eaten about

three acres of Mangolds nearly bare, taking the plants as soon as they appeared above ground; also from Cwmbran, near Newport, Mon., "destroying what promised to be a very fair crop of Mangolds"; and specimens of the Beet Carrion grub were also sent from Wiscombe Park, Honiton, Devon, with the intimation that it was doing a good deal of damage to Mangolds of some farmers near. But why the attack came in 1888, or why it did not recur, or was not reported as recurring, in the following year, we have no evidence to show.

The grubs are much like Wood-Lice in shape, and from about a third to half an inch or more in length when full-grown. The largest specimen which I have myself seen was about five-eighths of an inch long; the three rings or segments next to the head are rounded at the sides, but in the other segments they are sharp, so as to give the sides of the grub a saw-like appearance, and the tail segment has a sharp spine on each side. These grubs are black and shiny, sometimes with a little yellow at the front edge of the segment. When full-fed (which in the instances noted was about the end of June) the grubs bury themselves and form cells at the depth of three or four inches below the surface of the earth, in which they turn to pupæ, and from these the beetle has been seen to come up in about the space of a fortnight or three weeks.

These Beet "Carrion" Beetles, as they are called, from the mixed nature of their food, are flattish, of the shape figured (see page 11) at "5" and "6," about five lines long, brown-black, with a tawny down which easily rubs off, when the beetle appears as black (except the tip of the abdomen, which is dull red) and pitted all over. The eyes are large and oval, the horns club-shaped. The body behind the head is twice its width, and somewhat oval. The wing-cases are very flat, and turned up at the outer edge. Each wing-case has three sharp ridges running along it, the middle and outer ridge having a raised lump between them. The tip of the abdomen is dull red.

These beetles have large wings folded under the wing-cases. They may be found during winter or early in the spring sheltering under stones, or clods, or in moss or rotten wood, &c., and are common in April in dead animals.

Prevention and Remedies.—In common circumstances the eggs are laid in putrid matter, but where, or in what, the eggs are laid from which the grubs hatch that attack the Mangolds, does not appear to have been recorded. It may be under decaying matter in the field; the *S. atrata*, Linn., a black shiny species of which the grubs also feed at times on

Mangold leafage, has been found to lay eggs "in decaying leaves, or just at the surface of the ground"; but, looking at the nature of the beetle, it seems much more likely it should be in some specially rank kind of manure, and the eggs thus be brought, or the beetles thus attracted, to the field; offal and sea-weed, or shore-refuse, are special points to be looked to, and likewise the possibility of the beetles being brought amongst decayed leaves, in which they winter.

In the course of the special observations of Mr. D. Sym Scott, at Ballinacourte, Tipperary, Ireland, in 1888, it was noticed that the maggots attacked the young leaves much in the same way as the Turnip Sawfly, eating them completely down to the surface of the soil. They fed mostly during the evening and early morning, burying at the roots of the plant during the heat of the day. When the leaves were eaten off, the maggot attacked the tender root, and on the part of the field first attacked the root was gnawed off about a quarter of an inch beneath the surface of the drill. Where this happens of course the plant dies, but where the leaves were only eaten back (it was observed by Mr. Sym Scott) most of the plants, although late, recovered. This point is very important pratically, and attention was drawn to it some years ago by John Curtis, as a reason for *not clearing off a damaged crop over hastily*, for as soon as the grubs are full-grown they stop eating, and if the plants have life in them they will at once make growth. Also (as noticed by Mr. Sym Scott) attack will suddenly cease on a crop simply from the time of *change of the grubs to chrysalis state being come*, and all the damage consequently being over.

From previous records, as well as the more special observations of 1888, the time of attack appears to be chiefly during June, but sometimes noticeable towards the end of May, and in one case extending into July.

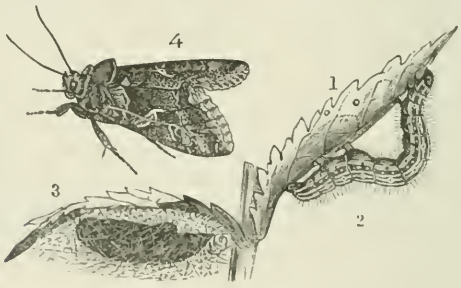
As the grubs go down into the ground to about three or four inches below the surface for the change to the chrysalis state, it would be a good means of preventing recurrence of the attack to disturb the surface, so as to throw these chrysalids out to be killed by exposure or by the birds. If all goes on naturally, and the grubs are left undisturbed, the beetles would come up from the ground in about three weeks after the maggots went down.

With regard to remedy when attack is present, nothing appears to have been observed, excepting that lime and salt have both failed to be useful; but it is very likely that dressings of a *small quantity* of paraffin mixed in dry earth or ashes, or the mixture of gas-lime, sulphur, &c., recommended some years ago by Mr. Fisher Hobbs as a Turnip Fly preventive,

would either of them be of service, if sprinkled when the dew was on, or on a damp day, so as to adhere to the leafage. As the insect was observed by Mr. Sym Scott to feed *during the night or when the leaves were moist*, the time chosen for dressing should correspond. The proportions of the above mixture are as follows:—One bushel of gas-lime, one bushel of lime fresh from the kiln, six pounds of sulphur, and ten pounds of soot, well mixed and powdered. To be applied early in the morning. The above is enough for two acres, and a broadcast machine is recommended as an expeditious way of spreading it. Dressings of guano and salt, or of any chemical manure suitable for running on good growth would be of great use during attack, which if it occurs at all is apt to be severe.

There does not appear to be any reason to suppose that this attack affects other field-crops than Beet or Mangold, although in one instance annual weeds consisting mainly of Chickweed were attacked in the infested field. Turnips and Carrots on the two sides of infested Mangolds escaped injury, and, judging from what has been recorded before, there would be no reason to fear danger to other crops put into infested ground, even when attack was known to be present, or *immediately* after attack. Besides Turnips and Carrots above mentioned, Parsnips, Potatoes, Peas, Beans and Cabbage have been recorded as all succeeding perfectly on land where the Mangolds had been destroyed.

The Silver Y Moth. *Plusia gamma*, Linn.



Moth, caterpillar, and pupa in cocoon.

This moth seldom causes much injury in England, but as it is always more or less about during the summer and autumn, and sometimes appears in vast numbers, it is desirable to notice it.

It is widespread in its localities; it is to be found over the northern half of the globe from Abyssinia to Greenland; it is said to extend to the frontiers of China and Siberia, and it is also prevalent in North America.

In 1735 the caterpillars did much damage to Peas and Beans in market gardens round Paris; in 1816 the moths were noticed in vast numbers in the northern part of France. In 1831 the caterpillars appeared in Bavaria, and in 1868 on the Sugar Beet in Saxony; and again in 1879 they appeared in Saxony in such overwhelming numbers that it is shown (from statements quoted in the 'Times' of Nov. 12th, 1879, p. 6, col. 1, of information given at the previous meeting of the Society for the Promotion of Sugar Beet Industry at Halle) that, "before the appearance of the moth and caterpillar, the Sugar Beet crops in Saxony were in excellent condition, and would in ordinary circumstances have yielded a harvest of from nine to ten tons per acre; the actual yield, where the caterpillars had been, was only three tons."

The moths generally lay their eggs beneath the leaves "in considerable clusters" (J. C.), singly; hatching in ten to fourteen days (E. L. T.); and although the caterpillars may be seen feeding by day, they are not easily to be observed, from their colour resembling the leaves. When full-grown they are green, with a green or brownish head, narrow white streaks along the back, and a yellow streak along each side; and are covered with short hairs. They have a pair of reddish brown feet on each of the three segments behind the head, but have only two pairs of sucker feet beneath the body, and one pair at the tail, these are all green. When full-fed they spin a woolly or silken cocoon in a leaf or on a stem, within which they change to a pitch-coloured chrysalis. The moths have the head, body between the wings, and crests running along the back and abdomen, of a purplish brown or deep ashy grey; the fore wings, which have a satiny lustre, are variously tinted with grey and brown, the distinguishing mark being a bright white or yellow figure resembling the letter of the Greek alphabet known as "Gamma" and the English "Y," whence the name of "Gamma" or Y Moth. The hinder wings are whitish, with dark veins, and a broad brown margin. The moths may be seen as early as April, but are most common towards autumn.—('Farm Insects,' 'Brit. Moths,' 'Prak. Insecten-Kunde,' &c.)

Prevention and Remedies.—These caterpillars feed on most of the low-growing plants, and also, if pressed for food, on the grasses; so that clearing weedy or grass-grown spots in or round gardens is a good means of prevention; nettles

especially should be removed, as these are one of their food-plants.

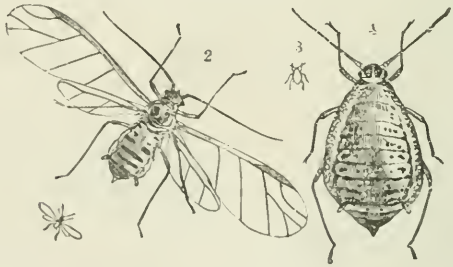
When the caterpillars are seen, a dusting of caustic lime, soot, or salt, is a good remedy; and hand-picking a sure, but very troublesome one.—(M. D.).

Shaking the infested plants or leaves (as may easily be done by a light blow with a small bough or birch-besom) so as to make the caterpillars fall off, and then trampling on them, is a good remedy.

Drenchings of liquid manure, or of water alone thrown over the plants, would be serviceable, from the circumstance of sudden wet being prejudicial to the caterpillars; and also—as from their great size they consume the leaves very rapidly—it is very important to stimulate the growth of the attacked plants as much as possible. Should a serious attack occur to field crops, many of the methods of remedy given in detail for caterpillars of moths, or of Sawfly on Turnips, would be applicable.

CABBAGE.

Cabbage Aphis (Cabbage Green Fly). *Aphis brassicæ*, Linn.



1 and 2, male Aphis; 3 and 4, female (nat. size, and magnified).

Cabbage Aphis.—These "Green Flies" may be found on the Cabbage in great numbers during the summer, clustered under the outer leaves, and also in the folds or on the upper side of the inner leaves; and some may be found remaining even as late as the end of November.

They do much harm by inserting their suckers in the plants and drawing away the juices; and also causing a deformed and diseased growth.

The young, when first hatched, are yellow. In the next stage (which answers to the *pupa* one, and whilst as yet they are without wings) they are much wrinkled, of a dirty green colour, with olive-green or grey-black wing-cases. The wingless females which produce living young are mealy, and when this meal is rubbed off they are of a greyish green, with black spots on each side of the back; eyes and legs black; antennæ (horns) green or ochreous, with black tips.

The winged viviparous female is of a yellowish green, with head and markings between the wings black, and some dark marks across the abdomen. The legs and antennæ dark brown, and a mark on the fore edge of the wings also dark. The male is given by Curtis as pea-green, otherwise it is much like the winged female, excepting in the mark on the wings being green; the antennæ longish and black, and the cornicles or honey-tubes black at the base.—('Farm Insects,' and 'Mon. of Brit. Aphides.')

Prevention and Remedies.—In garden cultivation, drenching the infested plants with soap-suds is practicable and of service, especially in killing the young Aphides.

Syringing with an infusion of tobacco mixed with lime-water has been found very useful, and the following mixture is also stated to be serviceable:—Four ounces of quassia boiled for ten minutes in a gallon of water, and a piece of soft-soap about four ounces in weight then added; and the mixture syringed over the plants. In this application the soft-soap is the important matter. From the mealy or powdery nature of the coats of the Aphides, mere waterings are apt to run off from them harmlessly, and adhesive applications like syringings of soft-soap are much surer remedies.

Thorough drenchings of water with the garden-engine, however, are of service, by forcibly clearing many of the Aphides from the plants and also by encouraging growth.

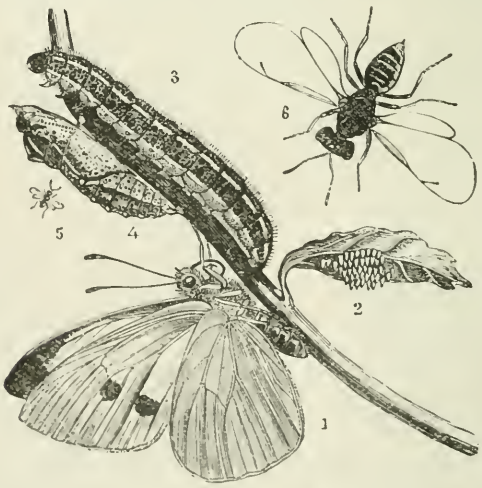
We all know the overwhelming increase of Green Fly that often happens when the plants are stunted by heat or disease,—or by the Aphis attack itself; and it is noted (see 'Mon. of Brit. Aphides,' by G. B. Buckton, F.R.S., vol. i. p. 72) that when the juices of the infested plants begin to fail and become sickly from excessive numbers of Aphides, a change commences in larvæ subsequently born. Signs of wings appear, and the viviparous females from these pupæ are winged; this different development, with its increased power of spreading attack, following apparently on the altered food.

This is curious as a scientific observation, and, if always

the case, watering would do much good by keeping up the flow of sap; and applications of liquid manure and such methods of cultivation generally as will keep the plants in vigorous health are to be advised, both as making the plants less suitable for the insects and also preserving them from important injury by any excepting severe attack.

A careful dusting with caustic lime or soot is also very effective in getting rid of the Aphis, and some amount of good may be done by carefully breaking off the leaves that are coated with Green Fly (as happens in a bad attack) and crushing them under foot, or putting them as they are gathered into a sack, so that they can be thrown either under water in the sack, or out into wet manure. Any way that will kill them at once will do. In the case of Aphides (as also with other insects of which one kind infests many kinds of crops), the remedies are mainly given in connection with the crops that are most attacked; the reader is referred, for further details of Aphides and remedies, to papers on Hops, Turnip, Plum, &c., and also to references to "emulsions," and soft-soap washes, in Index.

Large White Cabbage Butterfly. *Pieris brassicæ*, Linn.



1, Female butterfly; 2, eggs; 3, caterpillar; 4, chrysalis; 5 and 6, parasite Ichneumon-fly, *Pteromalus brassicæ*, nat. size and magnified.

The caterpillars of this butterfly are very destructive to the Cabbage crop by eating away the leaves until at times nothing is left but the large veins; they do serious damage to White

Mustard by feeding on the pods left for seed, and, in the case of Turnips, they feed on both the leaves and seed-pods.

The eggs are bright yellow, and are laid in clusters beneath the leaf.

The caterpillars are greenish at first, afterwards bluish or greenish above, yellow below, with a yellow line along the back, and another showing more or less plainly along each side; they are spotted with black, and have tufts or a sprinkling of hairs. When full-fed they wander off to some protected place, under old boards, beneath eaves, in open sheds, or the like places, and there hang themselves up by their tails and turn into chrysalids of a pale green colour spotted with black. The butterfly comes out in about a fortnight from the mid-summer brood of chrysalids, but not till the following spring from the chrysalids that form in autumn. The fore wings of the "Large White" Butterfly are white on the upper side, with a broad black patch at the tip, more or less notched on the inner side; in the female there are also two black spots in the middle of the wing, and a blackish splash at the hinder margin; the under side is white, with a yellow tip, and with two black spots, both in the male and female. The hind wings are white above, with a small black patch on the front margin, and beneath they are of a dull palish yellow, speckled with black.

Prevention and Remedies.—The habits of this species of Cabbage Butterfly and of the "Small White" are so much alike that the following methods of treatment are applicable in either case, excepting with regard to destruction of the eggs:—

The "Large White" lays its eggs in clusters beneath the leaves, and as soon as the Butterflies are noticeable, the eggs should be looked for, and the pieces of leaf covered with them torn off and destroyed. The eggs of the "Small White" and "Green-veined White" are laid singly, therefore this method of treatment is not applicable.

A most serviceable way to lessen the numbers of this pest—and one easily managed—is to have the chrysalids searched for and destroyed.

It has been observed that the proportion of injury from attack of Cabbage caterpillars is much larger to Cabbage crops grown in gardens where there are plenty of protected places, such as the caterpillar chooses for its change to the chrysalis state, than to the crops grown in fields where such shelter is not at hand.

When the first brood of caterpillars are full-grown, and have disappeared from the Cabbages in early summer, they

have left them to turn to chrysalids in any sheltered nook near, and may be collected in large numbers by children for a trifle per hundred. They may chiefly be found in outhouses, potting-sheds, and the like places, in every neglected corner, under rough stairs, step-ladders, or beams, or shelves; or fastened against rough stone walls or mortar. Out of doors they may be found under eaves, or palings, or under pieces of rough timber, broken boards, or any kind of dry sheltering rubbish.

It is very desirable not to allow these accumulations of rubbish, which are centres for all kinds of insect-vermin, but a thorough search in such places will produce handfuls of chrysalids, and thus greatly lessen the amount of the next brood of butterflies. In the winter, besides collecting the chrysalids, it is desirable at spare times to rub a strong birch-broom well up and down in the angles of the walls of sheds, or along the top of the walls beneath rough flooring, and thus make a complete clearing, before spring, of chrysalids from which the butterfly would then have hatched to start the first brood of caterpillars; the destruction of one female before laying her eggs prevents the appearance of scores of the grubs.

Hand-picking the caterpillars is a tedious remedy, but where there is no great extent of ground it is advisable as a certain cure. The application of finely-powdered lime in a caustic state, or of fresh soot, will get rid of the caterpillars, but may be objectionable with regard to after use of the vegetable.

A sprinkling of fine salt has been found very serviceable, carefully applied, so as to fall on the caterpillars; and they may also be killed by waterings of weak brine, lime-water, or soap-suds.—(M. D.)

Flour of sulphur dredged over the plants, or a weak solution of alum lightly syringed on the leaves, have not, so far as I am aware, yet been experimented with; but, looking at the success of these remedies in other cases, they are well worth a trial.

Many kinds of dressings, such as wood-ashes, &c., have sometimes succeeded, and sometimes failed so entirely that it is probable some point in the method or the time of application needs attention. It often happens that a dusting given when the dew is on, or after light watering (so as to make it adhere to the caterpillar and also to the plant), is of great service, whilst the same application given in the middle of the day is perfectly useless.

In the case of hearted Cabbages, a sprinkling of anything that would fall or wash down into the nooks of the Cabbage and lodge there, making it disagreeable to the grubs, would be

of use, and for this purpose gas-lime that has been taken from the surface of a heap exposed to weather for about two months seems to answer. The lime (as tried on a small scale) does not injure the leaves, and the various "pests" infesting hearted Cabbage do not like it at all.

When seed-crops are attacked, it has been suggested as a good plan to shake the plants so as to make the caterpillars drop off, and to have a number of ducks ready to eat them as they fall. Probably if a boy was substituted, with a basket of soot or quick-lime to throw over the caterpillars, or if he trampled on them, or a ring of gas-lime was thrown round each plant to keep the caterpillars from returning up the stem, it would do much more good than the ducks. The large flocks of ducks or poultry sometimes recommended may do much good, but there is a direct outlay for their purchase and food—as they need something besides the caterpillars; they must also be tended, or they will do harm as well as good, and altogether, except on a small scale, where the proprietor's poultry can be turned on and benefit by the open run and change of diet, the plan of clearing insect-attack by this means seems rather doubtful economy.

It has been noted that caterpillars of the Cabbage Butterfly which appeared healthy up to a given date, immediately after (following on sudden rain) perished, and were found to have become mere lax skins containing a cream-coloured fluid.—(J. C.)

Many kinds of caterpillars are attacked by purging when feeding on wet leaves, and, looking at these points and also that dry weather is the time when these special pests most abound, it appears likely that a good drenching from anything, such as a hose or garden-engine down to a watering-pot, if nothing better was at hand, might do much good; firstly, it would probably make many of the caterpillars fall off, and, if treated as above mentioned (that is, killed, or means taken to prevent their return), many might be got rid of; and secondly, though artificial means would not help us as much as the change of weather, still the sudden chill from the cold water, and the wet state of the food which would be induced if the operation was performed in the evening, would probably clear off many.

Good cultivation and heavy manuring of the ground, thereby running the plants on quickly, has been found serviceable; and the application of liquid manure will save a crop, even when badly infested.

If, by manure or cultivation, the crop can be kept in a state of growth that will make a larger amount of leafage per day to each plant than the caterpillars on that plant consume, all

will be well; but if, through drought, poor ground, or any other cause, the caterpillars take more off than the plant makes good, necessarily it gradually dwindles or perishes. This point is a most important one to be considered in attacks of this nature, and especially with regard to field crops, in the case of which it is most difficult to employ any kind of insect-preventive in the shape of dressing, remuneratively.

Severe cold in winter cannot be reckoned on as a means of getting rid of the chrysalids, which is the state in which these butterflies usually pass the winter. They have been found attached to walls, and frozen so hard that they could be snapped like sticks: yet those kept for observation appeared perfectly healthy on being thawed, and produced butterflies in due time.—(J. A. R.)

During the severe winter of 1878-79, chrysalids of the Cabbage Butterflies which I had opportunity of examining appeared perfectly uninjured by cold, which ranged at various temperatures between 10° and 30° on twenty-five nights in January. The parasite maggots in a chrysalis of the Green-veined White Butterfly were also only temporarily stiffened.

The number of butterflies is much kept down by the various kinds of small parasite flies which lay their eggs in the caterpillars or chrysalids, and especially by one kind of Ichneumon Fly (*Microgaster glomeratus*), which lays sometimes more than sixty eggs in one caterpillar of the "Large White." The maggots from these eggs feed inside on all the parts not necessary to the caterpillar's life till the time comes for it to change to the chrysalis, when, instead of turning, it dies; the Ichneumon maggots eat their way out and spin their little yellow cocoons (like small silkworm cocoons) often seen on Cabbages, from which a small four-winged fly presently appears.—(J. C.) These cocoons should *not* be destroyed.

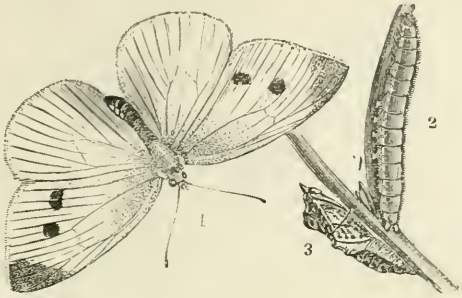
Another kind of Ichneumon Fly, the *Pteromalus brassicæ*, figured above, lays its eggs on the chrysalis when it has just cast its caterpillar-skin, and is soft and tender. The maggots, averaging two hundred and fifty in number, eat their way into the chrysalis as soon as they hatch, and feed on its contents.

Wasps also help to keep the butterflies in check, and have been observed especially to attack the "Small White," or Turnip Butterfly.

Small White Cabbage Butterfly. *Pieris rapæ*, Linn.

The caterpillar of this butterfly (known also as the Turnip Butterfly) feeds on Cabbage, also on Turnip, from which it takes its name of Turnip Butterfly; and also on the inner

leaves of the hearted Cabbage, whence the name sometimes given of Heart-Worm.



Small White Cabbage Butterfly: 1, female; 2, caterpillar; 3, chrysalis.

The egg is laid singly (not in clusters).

The caterpillars are green, paler green beneath, and velvety; and have a yellowish stripe along the back, and a stripe or row of spots of the same colour along each side.

The chrysalis is of a pale flesh-brown or greenish colour, freckled with black.

The fore wings of the butterfly are creamy white, with a slight grey or blackish patch at the tip (this patch not as long nor as regular in shape as in the Large Garden White). The fore wings have also one black spot above in the males, and two in the females. The under side of the fore wings is white, yellow at the tip, and has two black spots both in male and female.

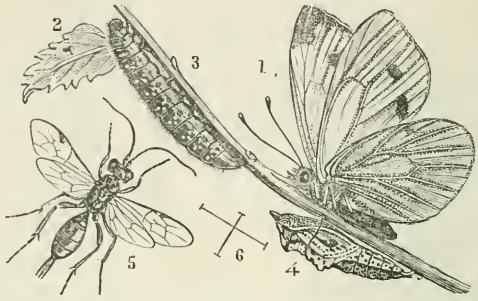
The hind wings are creamy white above, with a black spot on the front edge; the under side yellow, thickly speckled with black towards the base.

Prevention and Remedies.—For these, see the foregoing recommended for the White Cabbage Butterfly.

Green-veined White Butterfly. *Pieris napi*, Linn.

The eggs of the "Green-veined White," which is known also as the "Rape-seed Butterfly," are laid singly under the leaves of Turnips and Cabbages, and though it is doubtful whether the caterpillars are often injurious to any serious extent, they are noted by Curtis as feeding on Turnip-leaves in 1841, and in the same year as doing much mischief to the hearted Cabbages, by gnawing into the middle of them, like the caterpillar of the Cabbage Moth.

The grub or caterpillar of this "Green-veined" butterfly is velvety; of a dull green above, brighter below, and has a row of red or reddish yellow breathing-pores along each side.



Green-veined White Butterfly: 1, female; 2, egg; 3, caterpillar; 4, chrysalis; 5 & 6, parasite Ichneumon Fly, *Hemiteles melanarius*, mag. and nat. size.

The chrysalis is pale greenish white, or yellow and freckled, and has the two ends of a brown colour.

The fore wings of the butterflies are white above, excepting at the base, which is generally black; the tip also is dusky or black, and the nerves or veins greyish; in the females the markings are blacker than in the male, and there are also two large black spots beyond the middle of the wing (the males have sometimes one spot). The under side of the fore wings is yellow at the tip, with dark veins, and two black spots. The hind wings white above, with a dusky mark on the front margin; beneath they are sulphur or pale yellow, with broad greenish margins to the nerves.

Prevention and Remedies.—See "Large White."

Note.—The three species of Cabbage and Turnip Butterflies just described are so much alike that it may be convenient to point out the main distinctions:—

Eggs.—The "Large White" lays its eggs in *clusters;* the two other kinds lay them *singly.*

Caterpillars.—The caterpillar of the "Large White" is bluish green above, with three lines of yellow, and is *spotted with black;* also has *tufts, or a sprinkling* of hairs. The caterpillars of the two other kinds are green, but *have no black* blotches; also they are *velvety.* These two kinds differ from each other in the "Small White" having three yellow *lines,* and the "Veined White" having a row along each side of red or reddish yellow *breathing-pores.*

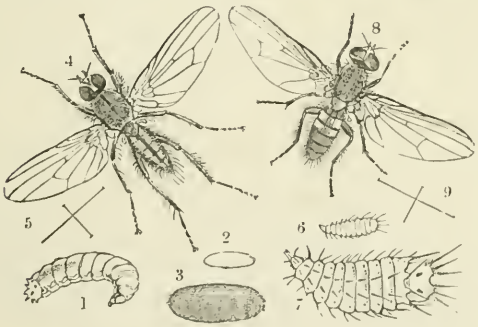
Chrysalids.—The chrysalis of the "Large White" is pale greenish, spotted with black; of the "Small White" fleshy-brown, freckled with black; and of the "Green-veined White"

pale greenish white, or yellow and freckled, with each end brown.

Butterflies.—The "Large White" usually measures about two and a half to three inches in the spread of the wings; the two other kinds are only about two inches. With regard to the markings,—in the "Large White" the patch at the tip of the fore wings is much larger, blacker, and more regularly notched on the inner side than it is in the "Small White"; also the males of the "Large White" have no spot (or rarely have it) on the centre of the fore wings, whilst there is usually one in the case of the "Small White."

Each of the above may be easily known from the other common kind—the "Green-veined White"—by *not* having broad green veins on the under side of the hind wings.—(J. C., J. F. S., and J. O. W.)

Cabbage Fly. *Anthomyia brassicæ*, Bouché.
Root Fly. ,, *radicum*, Linn.
Radish Fly. ,, *floralis*, Fallen.



1, Larva of *Anthomyia brassicæ;* 2 and 3, pupæ, nat. size and magnified 4, *A. radicum*, magnified; 5, nat. size; 6—9, *A. tuberosa*, larva and fly, nat. size and magnified.

There are certainly at least three different kinds of flies which cause the attacks known as those of Cabbage, and Turnip root maggots. These are so like both in the appearance of the flies and maggots and the method of injury that it is difficult to distinguish between them, and the history of the *Anthomyia brassicæ* which has been most fully recorded serves as a guide to that of the three kinds.*

* From specimens sent me during the prevalence of bad Cabbage root maggot attack during 1883, and previously, which were kindly identified for me by Mr. R. H. Meade, of Bradford, the commonest kind appeared to be that known as the Radish Fly.—E. A. O.

The maggots of these flies injure the Cabbage-crop by eating passages in the stem and roots, and sometimes destroying whole fields of Cabbage by consequent disease, or decay in wet weather, of the roots and the lower part of the stalk. They are also injurious to Turnips. The maggots may be found in hollows of the swollen Cabbage-roots. They are whitish, cylindrical, and legless; tapering to the head, and blunt at the tail, which has short teeth on the lower margin and two brown tubercles in the middle; and when full-grown they are about the third of an inch long. They then leave the plants and turn, in the earth, to pupæ (that is, their skins harden into oval red-brown cases), with a few black spots at the head, and short teeth at the tail, inside which the flies form and come out in about a fortnight or three weeks. These flies are on the wing throughout the summer, and successive generations of maggots are kept up till November; after that time the pupæ lie in the ground unhatched till spring or early summer. The fly is ashy grey, and smaller than the Onion Fly, which it much resembles. The male, however, is of a darker grey, and has a short black stripe along the back between the wings, with a curved one on each side of it, and one black stripe along the abdomen. The female is much smaller than that of the Onion Fly, otherwise is very like it.—('Farm Insects,' 'Gard. Chron. and Ag. Gazette.')

Prevention and Remedies.—Cabbage and Turnip maggots are to be found in dung, as well as at the plant roots; and reports show particularly bad attack being connected with planting or drilling on good supply of farm-manure, especially if this was in *new*, *rank* state. In one instance, where twelve to fourteen loads per acre of farm-manure, with three cwt. of burnt ashes and artificial manure was given, and the seed drilled immediately, maggot attack was bad; whilst the head-lands, treated only with burnt ashes and artificial manure, continued free of attack. Similarly, in a twelve-acre field dressed with three tons of fresh-burned lime to the acre, with the exception of a strip eighteen yards wide down the centre of the field, where *no* lime was given, but well rotted farm-manure at the rate of fifteen tons the acre, the Turnips on the limed part were "free from mark of insect or grub of any kind; whilst the part that had been manured was far from being so satisfactory." Other accounts confirm prevalence of maggot presence after the application of much dung.*

To grow Cabbage well without a good supply of strong forcing manure appears an impossibility; but accompanying

* For special observations on Cabbage and Turnip root maggot, see p. 10—17 of 'Report on Injurious Insects' for 1883 pub. 1884, by Ed.

applications, such as dressings of gas-lime, which make the ground thoroughly obnoxious to the flies and maggots, and increase at the same time the action of the manure, have been found very serviceable.

It was reported to me from one of the chief growers in the great Cabbage-raising district near Hounslow, as follows:—

"I believe gas-lime to be the only practical cure for the maggot tribe that infest our Brussels-sprouts, Broccoli and Cabbage tribe"; and near Falkirk, N. B. (to give an instance in a widely separated part of the country), where maggot was very bad in 1881, all the crop in one locality was saved that was planted on ground which had been dressed with gas-lime previously.

In all cases gas-lime must be used with moderation and discretion (*vide* Index for proportion and condition); also it should *not* be allowed to lie in heaps on the ground, or the land beneath will become poisoned for a while, but in due proportion the application is excellent. In continental practice the application of superphosphate of lime is advised as a means of prevention.

Rotation of crops in garden growing, and puddling or dipping the roots at planting time with soot and water or lime, or earth and cow-dung, or earth and night-soil are methods found useful to prevent attack.

Where plants have failed from maggot, and the ground had to be replanted, a handful of hot lime mixed where each plant was to be placed, before dibbling in, proved successful.—(J. R.)

When attack is present, heavy showers, or rain, on land previously dressed with nitrate of soda round the plants, and superphosphate, stopped the spread of the maggots. Also, the application of lime-water has been found very serviceable. The plan adopted was soaking hot lime for twenty-four hours in water, and watering with this, when clear, in the afternoon; this was found to destroy the maggot.—(J. M'K.)

Plants that are attacked by the maggots may be easily known by their yellow or dull lead-colour, and by the leaves drooping or fading in the heat of the day; and unless the attack is checked, as above mentioned, these plants should be carefully removed and burnt, or got rid of in any way that may make sure of destroying the maggots in them; and any liquid application, such as strong brine, or ley of ashes, such as will poison them should be poured into the holes to kill any maggots that have been left.

The practice of taking one crop of Cabbage after another off the same ground creates a nursery for the propagation of all the insect-pests which prey on this crop; and in the case

of such as turn to pupa in the earth, the grubs or caterpillars simply leave the roots, or descend from the plants into the ground, and there undergo their transformations. This may be immediately, or they may be in the earth during the winter, to appear as perfect insects in the ensuing spring or summer, and so on successively till the ground is completely infested by them.

It will thus be seen that a simple turning over of the ground, accompanied by heavy manuring, though it may be a remedy for the exhaustion of the soil, will not get rid of the grubs.

A change of crop is necessary—such as Beans, Cereals, or even Potatoes; these would not suit the Cabbage Fly for the deposit of its eggs, and planting the Cabbage afterwards on the clean uninfested land would greatly reduce the risk of attack.

The grubs of the Root-eating Fly, *Anthomyia radicum*, Curtis, are of a yellowish ochre-colour, with two dark brown points at the end of the blunt tail. The pupæ are of a paler and more ochreous colour than those of the Cabbage Fly.

The Root-eating Fly is figured at 4, p. 25, magnified; the male has an ochreous face, with a rusty stripe on the forehead; body between the wings black, with three dark stripes, and grey sides; abdomen slender, grey, with broad black stripe along the back. The female is grey, with three dull stripes along the body between the wings.

According to Bouché, the flies inhabit dung by thousands in the summer, and, from the nature of the excrementitious matter which they are stated by him especially to frequent, it would appear that the use of night-soil as a manure would be likely to attract attack.

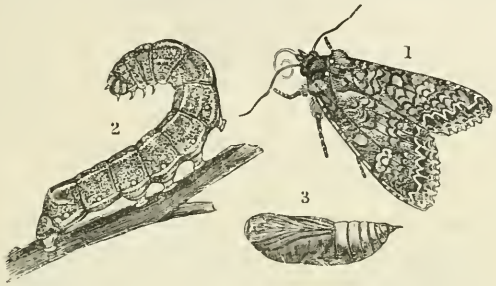
From experiments made by the Zoological-Botanical Society of Vienna, it appears that these maggots were injurious to crops on ground manured with bone-dust, and also to those manured with horse-dung; but that on ground close by, manured with superphosphate, the plants were not at all attacked.

Anthomyia tuberosa, Linn., figured p. 25, has been found feeding in Potatoes, and the larvæ and pupæ have been found where garden-ground has been long occupied by Cabbages.—('Farm Insects.')

Cabbage Moth. *Mamestra brassicæ*, Linn.

This is one of the garden-insects from which we suffer regularly in the summer and autumn of each year, sometimes slightly, but often to a serious extent. The caterpillars

do not seem to dislike the leafage of any of our common plants, whether sweet or acrid, and they may be found on Marigolds, Dahlias, and Geraniums, in the flower-garden, as well as on the leaves of the Tobacco; they frequent the Dock, amongst wild plants, and they are sometimes found on the leaves of the Red Currant; but we suffer most from their attacks on Cauliflower, and on the hearted Cabbages in the autumn.



Mamestra brassicæ: 1, moth; 2, caterpillar; 3, chrysalis.

Their appetite seems insatiable (they are stated to eat day and night), but however this may be, they soon ruin the Cabbage by gnawing large holes down into the heart, and making what is left truly disgusting, by the excrement from the caterpillars, which remains in lumps between the leaves, or spreads downwards in wet green masses.

The moth lays her eggs on the leaves, and the caterpillars hatch in a few days and immediately begin to feed. They are usually green in their early stages, but afterwards vary much in colour, some being pale dingy green; some green, and black above; some blackish above, variegated with flesh-colour, and on the back of each ring or segment there is a short line or somewhat triangular-shaped mark, lighter at the edge, and slanting backward. The head is ochreous, or marbled with darker brown, and the next segment to it is black above. When full-fed these caterpillars are upwards of an inch and a quarter in length, and on being annoyed roll themselves into a tight ring. They change to chestnut-coloured chrysalids in the earth (or sometimes on the surface), and usually pass the winter in this state, protected by earth. From these the moths come out in the course of the following May or later in the summer. The moths are of a rich brown, the upper wings are variously marked (as in the figure) with black streaks and circles, and have also a large ear-shaped spot, bordered with white and surrounded by a dark line; the lower wings are brown, dirty white at the base.—('Farm Insects,' 'Hist. of Brit. Moths.')

Prevention and Remedies.—Where the autumn Cabbage-crop has been much infested by the caterpillars, the chrysalids will be turned up in great numbers in the winter digging. When seen these should be immediately destroyed, or thrown into a basket to be effectually destroyed at the first leisure moment, and by this means the number of the next season's brood will be much diminished. It is no use leaving them to be killed by frost in undisturbed ground, because such kinds as have been tested at present will stand being frozen stiff without the slightest apparent injury, so long as they are left undisturbed in the cells or shelters which they have made for themselves. If, on the contrary, the caterpillars are thrown out on the surface to alternate cold and wet, this is an excellent way of getting rid of them.

Poultry are of service in clearing the ground of these chrysalids, as the common barn-door fowls are particularly fond of them; but hand-picking is the surer method.

When the caterpillars appear on the Cabbage it is very important to attend to them, in some way or other, at once. The grubs are very voracious, and very soon—by what they eat and what they spoil by their excrement—place the attacked Cabbage past all hope. Hand-picking is of use, and may be best done by children, as their small fingers are most suitable for getting between the folds of the Cabbage-leaves, and, under proper inspection, the Cabbages may be well and rapidly cleared at a small expense.

With regard to the hearted Cabbage, the application of gas-lime which has been exposed for about three months to atmospheric action—so as to neutralize its poisonous effects, but still not entirely to destroy the sulphury smell—has been found very serviceable. The powdered lime rolls down and lodges in all the nooks of the Cabbage, and thus makes the spots where the caterpillars most resort to, before piercing into the heart, the most distasteful to them. By comparison of gas-limed and unlimed plants in one garden, the effect has been found to be good in keeping down the grubs, without the least injury to the Cabbage. Sprinkling a good dressing of the gas-lime in this state on the surface of the Cabbage-bed is a very good preventive to attack, and acts well as a manure.

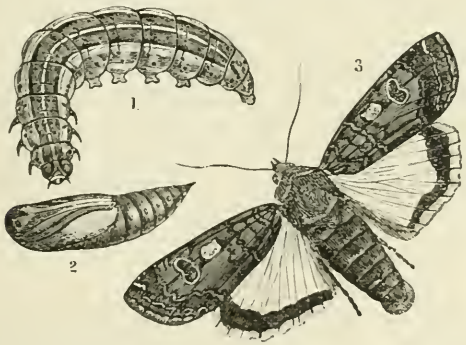
In my own garden I have found less harm done by these caterpillars to Cabbage planted in rows amongst other crops (as between Celery-trenches) than where the Cabbage was planted in a bed. Also, clearing off such of the lower leaves of the Cabbage as lay on the ground appeared a very useful plan. Many of the leaves were partly decayed and of little use to the plant, but gave shelter by day to such cater-

pillars as were straying about (besides slugs, &c.), and also gave much additional ease of access to the plants.

In the case of caterpillars that feed, like these, on many of our commonest weeds, it is desirable to clear away all such food-plants; and if the grubs have been noticed in summer in neglected corners, to turn over the ground in winter to see if the chrysalids are there, and, if so, to destroy them, or better still, trench down the ground, which will effectually get rid of them, if the ground is left undisturbed until past the right time for the moths to appear in the next year.—(' Farm Insects,' and Ed.)

Great Yellow Underwing Moth.

Noctua (*Tryphæna*) *pronuba*, Linn.



Tryphæna pronuba: 1, caterpillar; 2, chrysalis; 3, Moth.

The Yellow Underwings are much more observable than the grey Cabbage or Turnip Moths, by reason of their bright yellow under wings, banded with dark brown or black, from which they take their name, and which makes them very noticeable as they rise, towards the latter part of summer, before the passing foot in recently-mown grass or low-growing plants. Their chief time of flight is, however, in the evening or night. They lay their eggs in some quantity at the root of various kinds of plants about the middle of summer. The caterpillars hatch in about a fortnight. By day they lie hidden, rolled into a ring in the earth under their food-plants, or sheltered under clods, stones, or the like, and come out at night to feed. They have been found with the caterpillars of the Heart and Dart Moth at the roots of Turnips, and also at the roots of Lettuces, and have been stated by various authors to feed on the roots of grass. The lumps of dirt and gnawed leaves show their whereabouts.

During the winter months they may be found near the surface of the ground, and in spring they come out again and feed.

When full-grown the caterpillars are one inch and three-quarters long, and about as thick as a swan's quill. The head is ochreous, with two black stripes; the general colour is very variable, from a sickly green to a dull brown, variegated with rosy brown, and freckled with a brown band down the back, marked with a pale line along the middle, and a short line of black spots or streaks along each side; the caterpillar is pale green beneath. These caterpillars are very fat, not at all shining, and on being disturbed coil themselves into a ring. When full-fed, which may be from March to June, they bury themselves and form earth-cases or hollows in the ground, in which they turn to reddish chrysalids, from which the moths come out in June or July. They are variable in marking, but may be known by their pale or rich umber-brown fore wings generally mottled or spotted, as figured at 3, and by their hind wings being orange-yellow, with a somewhat narrow waved black band, but without any central mark. By one or other of the three points—their large size, the comparatively narrow black band on the hind wings, or the absence of the dull mark on the hind wings—this moth may be distinguished from other species of Yellow Underwings.

Prevention and Remedies. — The moth shelters itself amongst dry leaves and herbage, and in seasons when it is numerous many might be got rid of at a small expense by setting children to catch them with a bag-net, or merely with the hand. It rises before the passer-by from grass in hay-fields that have been lately cut, or in rough neglected spots; and its flight being sluggish, and itself large and very conspicuous from its "yellow under wings," it is easily taken.

In 1884, Mr. W. W. Glenny, of Barking, Essex, sent me specimens of this kind of Yellow Underwing Moth caterpillar, together with some of the common Turnip Moth and the following observation:—

"Surface-caterpillars have been exceedingly destructive, especially amongst the Cabbage seed-beds. . . . The most effectual way of checking them is to hunt for these caterpillars just below the surface periodically, say twice a week. By these means the attack may be lessened, and a crop saved.

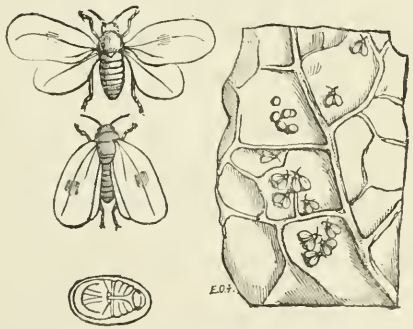
"This year having been dry, the caterpillars have given much trouble amongst transplanted Leeks, and one field of about four acres was searched more than once; the result was satisfactory, large numbers were destroyed, and the crop

in the main saved. In dry seasons like this the plants grow slowly, and the mischief done is more apparent; whilst in damp seasons the rapid increase of foliage makes the damage less noticeable."*

The same means are applicable for prevention that are recommended for destroying the Heart and Dart Moth, *A. exclamationis*, and most of the remedies against the Cabbage Moth, *M. brassicæ*, are also applicable to this one, but not all, as the Cabbage Moth caterpillar feeds by day as well as by night. The caterpillar of the Yellow Underwing feeds on Docks and on Bittersweet; consequently clearing these common weeds would be of much service.

Snowy Fly (Cabbage Powdered-wing).

Aleyrodes proletella, Linn.; *A. cheledonii*, Latr.



Aleyrodes proletella: Fly and pupa, much magnified; Flies on leaf, twice nat. size.

This is a small four-winged Fly, very like a small powdery White Moth in its appearance, but is in fact nearly allied to the Scale Insects and to the Aphides. It may be found on different kinds of Cabbage, more or less, all the year round, and towards autumn in such enormous quantities that, if the plants are stirred, the soft white flies will rise and float in the air, and settle down like miniature snow-flakes, whence its name of the Snowy Fly. They rest for the most part beneath the leaves, and draw away the sap with their suckers; and at times do a good deal of harm. The attacked leaves may generally be known by their patchy brown or yellow state, but sometimes are entirely discoloured.

* The above observation is well worth attention, as coming from such a first-rate authority as Mr. Glenny. For details of this method of treatment as practised in the Cabbage-growing district near Hounslow, for methods of prevention and remedy suitable for other kinds of "Surface-caterpillars," and for explanation of this term, see paper on "Turnip Moth."

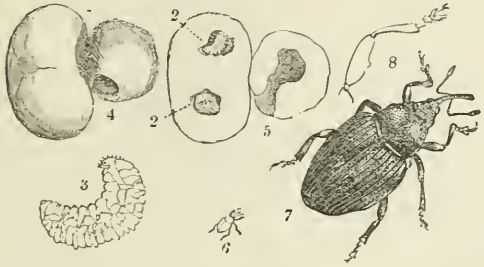
As far as is known, these Snowy Flies breed in winter as well as in summer.

The female lays her eggs in a patch on a leaf; these hatch in about twelve days, and the young spread themselves on the leaf and shortly become covered with a scale, white, with two yellow spots. In this state they much resemble the common Scale Insect, and they stick fast to the leaf, which they pierce with their sucker. In about ten days they turn (beneath this scale) to a pale chrysalis, with red eyes, and in about four days more the perfect insect comes out through the scale. This is very small, only about the eighth of an inch in the spread of the wings, and is covered with a white powder. The head and the body between the wings are black, variegated with yellow; the abdomen is yellow or rosy, and the four wings are white and mealy, the upper pair having a dusky spot in the middle and towards the tip. The head has a rostrum or sucking-tube with which it draws away the juice of the leaf.—('G. Chron.,' and 'Ag. Gazette,' 1846.)

Prevention and Remedies. — Cabbage infested by these Snowy Flies may be known by the unhealthy look of the leaves, which are sometimes withered, but more commonly marked with whitish or yellowish patches; and there is the unusual inconvenience that the creatures are to be found doing mischief all the year through. They have been observed to withstand rain and cold, and have been found in all stages in the middle of the winter. As the attack is mainly beneath the foliage, there is great difficulty in bringing any kind of dressing to bear on the insects; but dusting the plants with soot, or ashes sprinkled with tar, or if possible giving a good syringing with tobacco-water, or soft soap, might be of service. The best treatment, however, appears to be cutting off the infested Cabbage leaves and destroying them. This should be *thoroughly done, and at once*, as, if the leaves are only thrown to a rubbish-heap, they will remain fresh enough for some days to support many of the grubs up to the stage in which they turn to the chrysalis. Throwing the leaves to be trampled in farm-manure gets rid of them thoroughly, or burning amongst rubbish would answer better.

The Snowy Flies shelter in any convenient nooks on the surface of the ground, or under leaves; therefore, digging infested ground, or top-dressing with caustic lime would be of service.

Cabbage and Turnip Gall Weevil. *Centorhynchus sulcicollis*, Gyll.



1—5, Gall with maggots, nat. size and magnified; 6 and 7, Weevil, nat. size and magnified; 8, leg of Weevil, magnified.

The Cabbage and Turnip-gall Weevil does mischief by causing the growth of the smooth knobs, or clusters of knobs, often observable on the bulbs of Turnips and Swedes, and also on the underground part of the stem, or even the roots of various kinds of Cabbage. These galls do little harm in themselves, so far as Turnips are concerned,—that is, unless they are very numerous, or cause decay by wet lodging in the hollows in the galls, from which the maggots have escaped. But with Cabbage it is different. Here the gall-growths on the old stocks are not available for food as they are with Turnips; they carry off the sap in the wrong direction, besides inducing decay.

The Turnip and Cabbage-gall Weevil is a very small blackish beetle, about the eighth of an inch long, and of the shape figured above (magnified) which shows the long fine proboscis, or snout, with the "elbowed" antennæ, or horns, placed on each side; also the channel along the middle of the thorax, and striæ, or furrows, along the wing-cases. The colour is black, with grey or white scales beneath, and sometimes a sprinkling of them above.

The method of attack is for the female either to make little holes with her proboscis, in which to deposit her eggs, —usually one in each hole,—or else simply to lay them on the surface of the Turnip-bulb, or Cabbage-stock or root, as the case may be. The maggots which hatch from these eggs are, as figured, thick and legless, very much wrinkled across, and white or yellowish. The head is furnished with strong chestnut-coloured jaws, darker at the tips, and also armed at the tips with two teeth, and sometimes with a third much smaller tooth on the inner side.

The gall-maggots are for some time hardly observable within the galls, which their presence has given rise to, but

after a while, as they grow and eat out the centre of the gall with their strong jaws, they may be found either singly, in separate galls, or (where the galls are in clusters) there may be a group of little cells, communicating with each other inside, and each with a maggot within.

When full-fed the maggots leave the galls and make earth-cases, in which they turn to the pupal or chrysalis state. These cases they form by first securing a little bit of the material lying close to them with the tip of the tail, and then, with their jaws and moisture from the mouth, fastening on to this beginning little morsels of pebble, sticks, earth, or whatever may be within reach, and so forming a solid case around themselves. If disturbed in this operation, the maggot will drag its partly-formed case with it, or if the case, when newly made, is broken, I have seen the maggot complete it again. The quantity of moisture used in fastening the particles of earth together is so great, that wet patches can be observed inside the case as the work goes on. When complete the case or earth-cocoon is smooth inside, and lined with a kind of whitish or yellowish gummy material, and it lies in a hollow in the ground from which the material was taken. The time occupied from the maggot going into the ground to the perfect beetle coming up from it was between fifty-four days and two months in the middle of summer, in the instances that I watched.

The beetles may be found from spring onwards during summer, and some maggots still in the galls in winter; and the maggots bear being frozen hard without the slightest apparent injury, for on being thawed they will at once go down into soft earth and begin to build up their earth-cases.

Prevention and Remedy. — With regard to Turnips and Swedes, the simple fact that in common rotation the crop comes at sufficient interval to prevent the ground harbouring the weevils, or morsels of maggot-infested pieces from the preceding root-crop, is usually a great security; but where, in Cabbage-growing districts, one Cabbage crop may be put in after another, with only interval enough to lay a heavy application of manure on the land, the weevils are likely fairly to swarm.

Where Cabbage is a constant crop of the district, a great deal of good might be done by burning the infested old Cabbage-stocks when drawn from the fields, instead of throwing them into rot-heaps or of digging them into the ground, as is often done. In this case the maggots are perfectly well suited to take care of themselves; they go from the galls into the earth near them, and (unless the galls are very

deeply buried) in due time the beetles, with the help of their long boring beaks, will come up through the ground all well and strong; so that if Cabbage is planted over the buried stocks, it is most conveniently placed for the supply of the new brood. This may seem an overdrawn statement, but such treatment and results are only too true.

In common garden cultivation the old plants might easily be got rid of by throwing them to the pigs, or into a farm-yard where the grubs (if they came out) would be choked in wet manure. In field cultivation, where the stocks are cleared by the cart-load, it would be desirable to burn them, or shoot them into a field-pond away from houses where the smell would not cause annoyance, although it would hardly be worse in this way than when the old stocks lie rotting in heaps. But whatever is done, it should be done at once, before the maggots have time to leave the galls.

Rotation with other crops is the best cure, but where Cabbage (including under this term Rape, Cauliflowers, Brussels-sprouts, or other plants of the Cabbage tribe, wild or cultivated, that are liable to this infestation) must be constantly grown, then the best application to the land appears to be gas-lime.

With regard to amount of gas-lime that can be safely used, and the time of application, it should be laid on arable land when clear of crop in autumn or winter, and allowed to be exposed to the air for at least four weeks before being ploughed in. Thus, by exposure to the air, the nature of the lime, which at first does good by its acrid properties, killing what is subjected to it, is so altered that it is changed to sulphate of lime, a manure suitable for all land on which gypsum is of use, and especially serviceable to many leguminous crops and Turnips.

The quantity mentioned by Dr. Voelcker as safe is two tons per acre, applied as above; but the further amount that is desirable depends on the strength of the gas-lime, the nature of the soil, and other points as nature of succeeding crop, and time that can be allowed for the caustic gas-lime to be exposed. Those who wish to go into the nature and uses of gas-lime as an application to the soil will find excellent observations in Dr. Voelcker's four-page leaflet, of which the title is given below.*

Gas-lime has been found useful for clearing infested ground, applied broadcast and pointed-in, or as a dressing

* "On the Composition and Use of Gas-lime in Agriculture," by Dr. Augustus Voelcker; four pages. Reprinted from the Journal of 'Gas-lighting,' &c. Printed by W. King and Sell, 12, Gough Square, Fleet Street, London. (Probably procurable on application or through a bookseller).

accompanied by deep trenching. Where the area to be dealt with is not too great, trenching, if thoroughly done, is of great service in getting rid of attack, for if the top spit of land, with the maggot-cocoons or weevils in it, is turned down, and the lowest spit laid on the top, then the working part of the land (for a while at least) is purified from infestation. Dressings of fresh field-soil are very useful in infested gardens.

In planting seedlings, those that are much galled should be rejected. Wood-ashes are said to be a good preventive for attack on the roots, and dressings thrown on of sand, or ashes, or dry earth, with paraffin added in the proportion of one quart to a bushel of the dry material, would be very likely to be of service in preventing the weevils going down for egg-laying.

The diseased growths known as "Club" in Cabbage, and as "Anbury" or sometimes "Finger-and-Toe" in Turnips, consisting of swollen masses and misformed bulbs, passing on in bad cases to cracking and bursting of the surface followed by putrefaction, are not caused by Gall-weevils, or by any other kind of insect attacks, but by a kind of Slime Fungus, scientifically the *Plasmodiophora brassicæ* of Woronin. For information on this infestation and means of prevention and remedy, the reader is referred to observations by the late Dr. Augustus Voelcker, in his paper on "Anbury," in the 20th vol. of the 'Journal of the Royal Agricultural Society'; also to a paper on "Club-root," in 'Diseases of Field and Garden Crops,' by Worthington G. Smith (Macmillan, London); and in my own 12th 'Annual Report on Injurious Insects,' pp. 27—31, I give condensed observations from the above authorities, with some observations of my own, especially on the serviceableness of gas-lime for prevention of this fungoid attack.

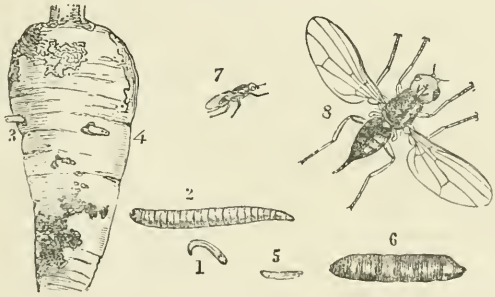
CARROT.

Carrot Fly. *Psila rosæ*, Fab.

The damage done by this "Worm" or maggot is known as "rust," from the peculiar reddish or rusty colour to which the gnawed parts turn.

The maggot is legless, white or yellowish, and shiny; about a quarter of an inch long, pointed at the head end, which is furnished within with a black horny apparatus of two curved

hooks for feeding with. The tail is truncate and rounded at the end, and has two small black breathing pores or spiracles. The grubs may be found in winter as well as summer, and attack all parts of the Carrot-root by gnawing galleries on the surface, or into the substance of the root; but whilst the roots are young, the grubs appear generally to attack the lowest part. If infested Carrots are carefully drawn from the earth, the grubs will be seen on the root, sticking out of their burrows by about half their length. The attacked Carrots may be known by the outer leaves turning yellow and withering, while the roots gradually sicken and die from the injury to the fleshy part, the growth of the root-fibre being also often completely destroyed.



1, 2, and 3, larvæ of Carrot Fly, nat. size and magnified; 4, infested Carrot; 5 and 6, pupæ; 7 and 8, Carrot Fly, nat. size and magnified.

When full-fed, the maggots leave the Carrots and turn to pupæ in the earth. These pupæ or fly-cases are shiny, of a rusty or ochre colour, pale russet at the ends, with two little black points at the tail. The fly comes out in three or four weeks in summer, but in winter the pupæ remain unchanged, and the fly does not come from them till the following spring or summer. It is very small, less than half an inch in the spread of the wings, blackish green, with a round, rusty, ochre-coloured head, and ochre-coloured legs. The abdomen is sharply pointed in the female, and the two wings are iridescent, with bright ochre-coloured veins. — ('Farm Insects.')

Prevention and Remedies.—The following notes regarding Carrot-cultivation will be found to bear in various ways, suitable to different circumstances of soil and climate, on the main points of—1st, such preparation of the ground in autumn or winter as will ensure favourable conditions for a healthy, vigorous, and uninterrupted growth from the first sprouting of the seed; 2nd, thinning at such a stage of

growth, in such circumstances of damp weather, or with such watering or treatment after thinning as may least expose the plants to the attack of the Carrot Fly, which frequently occurs after this operation. Whether the fly is attracted by the scent of the bruised plants, or what brings it is not clear, but it is very clear that as it goes down into the ground to lay its eggs on or by the Carrots, that all operations which leave the soil unusually loose and open, lay at the same time the Carrot-roots open to attack; and it will be observed that the various methods of treatment, in regard to thinning, bear on the means of meeting this difficulty. Observations as to kinds of manure, and special applications, as salt, gas-lime, wood-ashes, &c., found to be serviceable, are also given.

The notes are classed as far as possible in groups, with reference to the point mainly brought forward in the observation. The notes immediately following refer *to preparation of the ground and time of thinning.* At a locality near Dingwall, N.B., where the ground is a damp heavy clay, and consequently unsuitable for Carrots, a piece was prepared in 1874, on which they were found to answer very well subsequently year by year. The soil was removed to the depth of two feet, and replaced by a mixture of well-decayed leaf-mould, sand, charcoal, soot, and light soil; on this the Carrots have only suffered slight injury, when other beds in the neighbourhood have been destroyed by the fly.

It is advised that Carrots should be thinned out to the distance at which they are to be grown, when they are weeded the first time, for if they are thinned after they come to any size, the soil is opened round the Carrots, and if dry weather follows, the fly is sure to attack them.—G. M'K.

At another locality near Dingwall it was the custom to sow sparingly, and not thin the Carrots till fit for use; and—in illustration of attack of grub or "worm" following on thining—it was observed that in 1880, after commencing this process with the second sowing of Carrots, "the grub commenced too, and within three weeks spoiled them for use. Late ones alongside escaped until we began to use them; but by keeping to the side the grub was on, it kept up, but did not advance beyond the damaged part."—(A. S.)

"Unless the Carrots are thinned very early it should not be done till they are fit for use, as there is great danger of attracting the fly by the broken pieces of root remaining in the ground."—(A. A.)

At Dunrobin, N.B., the ground was carefully trenched, and the manure kept about a foot or fifteen inches from the surface; and it was the practice to use the best seed, sow thinly, and thin early, or not till the Carrots are fit for use.

"If Carrots require thinning, this should be done when an inch or two high; if thinned after they are from two to six inches high, the fly seems to attack them more readily."—(D. M.)

On ground near Kirkwall, in the Orkneys, where the soil was of a strong clayey nature, unsuitable for Carrots, it was found, after all previous experiments had failed to produce a good crop, that (instead of using ordinary manure) digging in about the same quantity of peat and sand, and giving a good watering with gas-water before sowing was quite successful.—(T. M'D.)

In a locality where the Carrot-crop suffered severely from the fly on the ordinary soil, a piece of peaty ground was taken for Carrot-growing which produced good crops yearly.—(J. D.)

In the following notices the soil appears to have suited the Carrots perfectly, *and the attack of fly to have followed on thinning*:—

At Lockerbie, N.B., where change of soil was tried as a remedy for fly, a portion of ground was cleared out to the depth of twenty-two inches, and the vacancy filled in with a compost of four parts good brown peat, four parts light fine yellow loam from Vinery border, two parts well-decayed leaf-mould, and two parts river-sand; the whole being thoroughly mixed, and no manure being used. The Carrots sown on this were thinned at the end of May, and did well till the 17th of June, when the fly was found to have begun its ravages.—(F. G. F.)

On a stiff clayey loam near Isleworth the same experiment was tried on a smaller scale, by removing soil to the depth of about eighteen inches and filling in the space with a mixture of about one-third decayed leaf-mould of Elm-leaves, one-third of the loam that had been dug out, and one-third of mixed coal-ashes, broken peat, and a little white sand. The Carrots did well on this till the end of June, when they were thinned, and the grub shortly after appeared amongst those most disturbed by the thinning. Copious watering with an occasional application of dilute Soluble Phenyle stopped the attack, and threw the Carrots into vigorous growth.—(Ed.)

The following notes have reference to methods of *cultivation of the ordinary garden ground, to the addition of salt and other occasional applications*:—

At Skibo, N. B., the course was adopted of having the ground double-dug before hard frost set in, the manure being put at the bottom of the trench. When complete, a good dressing of salt was given, which washes down before spring, and previous to sowing a good dressing of soot and wood-ashes was

applied. Care was taken to perform the first thinning as soon as the plants could be handled, leaving them an inch or two apart. When the thinning was complete a sprinkling of guano was given, and a thorough watering if the weather was dry. Particular attention was paid to keeping the Carrots growing without any check till some time after they are finally thinned, when, if all has gone well previously, they are considered safe. Still, however, it is thought well to look them over occasionally, and if any are found drooping, to have them pulled up and burned. This method of cultivation has been found after many years' experience to answer well.—(A. F.)

Near Berridale, N. B., the method adopted was to turn up the ground in winter as roughly as possible, and give a good dressing of salt. In spring, before sowing, it was forked over, and a dressing given of peat and ashes. When the Carrots are thinned, a mixture of soot and water was poured over them; and paraffin also used, in the proportion of an English pint of paraffin to two gallons of water, but care is recommended in the use of it in dry weather, lest it should burn the plants.—(J. S.)

Frequent waterings of salt water are mentioned as of service to an attacked crop.—(T. M'D.)

At Dalkeith, N. B., good Carrots, tolerably free from injury by the fly, were grown on ground which had been previously heavily salted for Asparagus. This was upon soil which had been used for a kitchen-garden for forty years, and upon which endeavours had failed to get a good crop in any other way.—(M. D.)

At Ballinacourte, Tipperary, the most severe portion of an attack of the Carrot Fly occurred in the centre of a field which had not received the same treatment as the part round it, and the plant was consequently more feeble. In this case bad manure and the absence of salt were considered to be the cause of the attack. It is advised that good manure—rich and well rotted—should be applied at the autumn ploughing, and artificial manure, with salt, applied in the drill at sowing-time.—(D. S. S).

In the following notes mention is made of the use of *paraffin in regular course of cultivation, or as a dressing in case of attack, proving a very good means of prevention*:—

The crops have usually proved good at Oxenford Castle, N. B., on a bed of tree-leaves covered with soil composed of emptyings of flower-pots, boxes, &c., and consequently of a light, friable nature. In 1879, however, the fly proved destructive, and in 1880, in order to experiment, the beds were beaten firm after the seed was sown, and lightly covered with soil, as above mentioned. A good dressing was then

given with wood-ashes in which paraffin oil had been mixed in the proportion of one quart to a barrow-load of ashes (about one hundredweight). When the plants were about four inches high, a second dressing of the same mixture was given, and a thoroughly excellent and luxuriant crop resulted. It is observed that mixing the paraffin with some absorbing substance is better than simply watering with it in a dilute form, as it lasts longer, and is more gradually carried down into the soil.—(A. A.)

Sand saturated with paraffin oil and strewed amongst the Carrots, and afterwards watered in, was noticed as a good preventive.—(G. M'K.)

At Hopetoun, N. B., the Carrot-crop was not satisfactory till the use of paraffin oil (in the proportion of two wine-glassfuls to a gallon of water) run along the drills after thinning was tried, and proved very successful.—(D. M'L.)

Watering with paraffin oil in the proportion of a wine-glassful to a gallon of water has been found to be of service. —(R. S.)

It is also noted that, in an attack of the Carrot Worm near Guildford, Surrey, the patches to which a dressing of paraffin and soot were applied turned out well, and yielded good roots.

The following notes refer more especially to the *successful use of gas-lime, wood-ashes, and soap-suds, and also to successful cultivation on ground which has a liberal supply of rich manure thoroughly incorporated with it by the cultivation of the previous crop*:—

It was mentioned that at Marchmont, N. B., the system adopted is deep trenching after Celery, and cropping with Carrots without addition of manure, and as long as this practice was adhered to, the fly rarely appeared.—(P. L.)

At Dalkeith, a dressing of gas-lime forked into the soil before sowing was found to be a good remedy, as also was an application of ammoniacal liquor or strong liquid manure, whenever the Carrot Fly is first noticed on the wing.—(M. D.)

At Callander, N. B., where the grub has been found troublesome, the use of gas-lime was tried with success. The ground was rough dug at the beginning of winter, and the gas-lime was sprinkled over the ground till it was white, and then pointed-in about four inches. The Carrots on ground so treated escaped all attack from fly, whilst those on another piece not so treated were destroyed; and a second sowing made to replace these on ground dressed with gas-lime also did well.—(T. B.)

Gas-lime dug two or three inches thick into the bed before sowing was found to answer at Hopetoun; but it is observed that perhaps the best and cheapest cure for the worm in

Carrots is a solution of alum in water, applied by a watering-can with a rose. This is mentioned as perhaps even better than paraffin, as there is less risk of misapplication.—(J. M. L.)

A note of treatment, in 1879, at Gordon Castle, Fochabers, points to the effect of wood-ashes in preventing attacks so far down the root as the alkali is carried in solution by the rain. Some of the ground was trenched, other portions sown without trenching, but the whole otherwise treated alike,—that is, by covering over the seeds in the drills with fully half an inch thick of sifted wood-ashes. The Carrots were all attacked by the grub, and proved an entire failure; but it is noted the attack was about two and a half to three and a half inches below the surface, the upper part of the Carrots remaining perfectly sound.—(J. W.)

Wood-ashes are noted as applied in successful treatment, after the ridges are levelled, in a dressing not less than half an inch all over the ground; this is dug-in one spit deep (the ground being made level at the same time), and soot well dusted over the surface. The ground is then ready for the seed.—(A. I.)

At Torloisk, in the Island of Mull, the ground was trenched about two feet deep, and a good layer of farm-manure placed at the bottom of the trench in winter, and prepared in the usual way in the spring; but before sowing, deep holes were made about eight inches apart, and filled with a compost of soil from potting-shed, soot, pigeon-manure, lime-rubbish, sea-sand, and wood-ashes, and a few seeds were placed in each hole. The result was an excellent crop of clean Carrots; but a few lines tried without the holes, but with a little of the compost in lines beneath the seed, were destroyed.—(A. G.)

The simple application of frequent waterings has a very good effect in keeping down "rust" or attack of Carrot grub in dry weather. The water keeps the ground fairly compacted against entrance of the fly for oviposition, and also keeps the plants from falling into the checked and stunted condition in which they are particularly liable to attack; and if given with a rose over the foliage, the watering has the further advantage of clearing out, for the time being, all flies which are harbouring there, and which at once take wing before the falling shower.

One more remedy remains to be named, which has been recommended for such a long course of years that presumably it is of service. This is, to prepare ground for Carrots by a dressing of spirits of tar mixed with sand. One gallon of spirits of tar well mixed with a barrowful of sand and then hand-strewed over the ground, is enough to dress sixty or seventy square yards. This dressing may be applied in the

autumn and dug-in, or after the Carrots are sown, or it may be strewed at the time of sowing.

The above observations give a variety of means, all tending to the same results of pushing on healthy uninterrupted growth, with such subsequent treatment as will either not induce attack of the fly, or is likely to counteract attack, if it occurs.

To these methods of cultivation a note may be added regarding treatment of ground on which there has been a badly-infested crop of Carrots:—

Although the summer broods hatch in three or four weeks, the maggots may be found in the roots during winter, and they change to pupæ in the earth adjacent. It is therefore very desirable that all infested Carrot-beds should be thoroughly cleared of roots in the autumn, and the ground well dug, or trenched, so that such maggots or pupæ as remain in the bed may be destroyed; some may escape, but the larger number will thus be buried too deeply to come up again, or be thrown on the surface to the birds; and a dressing of gas-lime will be serviceable in destroying such of the grubs as are lying near the surface.

Common Flat-body Moth. *Depressaria cicutella*, Curtis.

Common Flat-body Moth, caterpillar, and chrysalis.

This little moth is one of three nearly-allied kinds, of which the caterpillars injure our Carrots, and sometimes also our Parsnip-crops. I only give a figure of one kind, as they are

much alike in shape. They may be known by the rather long and narrow upper wings being laid flat one over the other when at rest, and by the abdomen being flat or depressed, whence the common name of Flat-body Moth, and the scientific name of *Depressaria*.

The caterpillar of the moth described above feeds on the Carrot-leaves, which it cuts so that it can bend and roll them up into small cylinders spun together by its threads; each end is left open, so that when alarmed it can lower itself to the ground by a thread spun from its mouth. It is about half an inch long, grass-green, with a darker green line along the back and along each side; it has ten warty black spots on each ring, a brown head, with two brighter brown spots, and the back of the segment behind the head is brown, with a black margin. When ready to change, the caterpillars become rosy beneath, and then turn to chrysalids of a deep yellowish brown, sometimes in a folded leaf, sometimes in cocoons in the earth.

The moth is rather more than three-quarters of an inch in the spread of the wings, shiny like satin, of a pale reddish ochre-colour, the upper wings freckled with brown and black, and with two or three white dots with dark edges towards the middle; the under wings are yellowish grey, satiny, and fringed.

There are two broods. The June caterpillars come out as moths in August; those found at the beginning of September come out as moths (which live through the winter) at the end of November.—(From 'Farm Insects.')

Prevention and Remedies.—I am not aware that the caterpillar causes serious damage in England. Should it be troublesome, probably shaking the Carrot-leaves with a stick, or in any other convenient way, and throwing soot, or lime, or anything that would injure the caterpillars and keep them from returning to the leaves, would be serviceable; they fall on being disturbed.

Their natural enemies are the small Solitary Wasps (*Odyneri*) which may often be seen in summer, and are distinguishable from the Common Wasps by being generally smaller, and by their large heads, and the broad stripes of black on the sharply-pointed abdomen. These small wasps make their burrows in sand-banks, bramble-stems, decayed posts, and the like places, in which they collect caterpillars for the food of their own larvæ.

Carrot-blossom Moth. *Depressaria daucella*, Curtis.

The caterpillars of this small moth sometimes do much harm to the Carrot seed-crop in July and August.

They draw the tips of the flowering head (the umbel) together with their webs, and inside this chamber they feed on the flowers and seeds.

The caterpillar is greenish grey, or yellowish, with black hairy warts, and some faint streaks along the back; and the head, as well as the upper side of the first segment behind it, is brown or black; it is only about half an inch long when full-grown.

Sometimes the caterpillar changes to the chrysalis in the flower-head; sometimes it bores for this purpose into the stem.

The moth is little more than three-quarters of an inch in the spread of the upper wings. The head and body between the wings are reddish brown, freckled with black; the upper wings are of the same colour, freckled with white, and having black streaks, and the under side is dark; the hind wings are light grey.

Prevention and Remedies.—The caterpillars fall down by a thread when disturbed, therefore shaking the Carrot-tops and destroying the caterpillars that fall is a good remedy; but it should be remembered that unless the grub is immediately destroyed, or its return prevented, it will go back again, and no good will be done by the shaking.

Powdered hellebore is suggested as being a good thing to dust over the infested plants, applied when the dew is on.

It is stated by various writers that this moth much prefers the Parsnip to the Carrot for deposit of her eggs, and consequently, by planting Parsnips about eight feet apart amongst the Carrots, the latter will be saved from attack, and also the Parsnip-tops, with the caterpillars and chrysalids thus collected, may be conveniently gathered and burnt. This, however, needs a deal of care, or the caterpillars will drop down by their threads and escape. Breaking the heads off over a tub is suggested as a good remedy by John Curtis in 'Farm Insects,' from which the above notes regarding Carrot Moths have chiefly been taken; but it would be well in this case to have a thick mixture of soot and water, or quick-lime, or anything that would destroy them at once or prevent their escape, placed at the bottom of the tub, rather than to depend on burning.

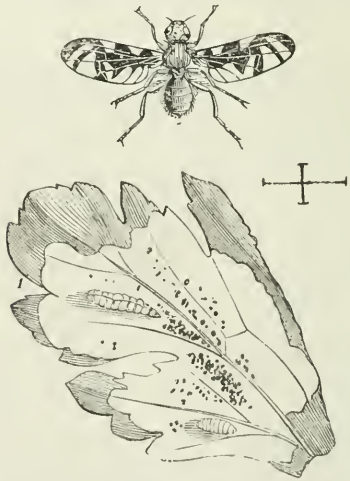
Purple Carrot-seed Moth. *Depressaria depressella*, Curtis.

The caterpillars of this moth resemble, both in habits and appearance, those of the Carrot-blossom Moth, but are rather smaller, being hardly more than a quarter of an inch long. They are brownish grey in colour, and the black hairs grow from white instead of from black warts. The sides of the body have swollen edges. Their food-plants appear like those of the Carrot-blossom Moth—as also means of prevention, &c.

Note.—The scientific names of the species of *Depressaria* are those given by Curtis in his ' Farm Insects.'

CELERY.

Celery and Parsnip Fly.
Tephritis onopordinis, Fab.; *Trypeta onopordinis*, Meig.



Tephritis onopordinis: fly, magnified; line showing nat. size; maggot and pupa figured in blistered leaf.

These flies infest the leafage of both Celery and Parsnip, but as it is the former of the two crops that usually suffers most, I have placed the observations under the heading of Celery.

The Celery Fly lays her eggs on, or in, the Celery-leaf, and from these there hatch maggots of the shape figured above. These maggots are fleshy, legless, pointed at the head, and

blunt at the tail, white or pale greenish in colour. They feed between the upper and under sides of the Celery-leaf, and, by eating away the substance, cause large blister-like patches, which are white at first, and turn brown as the skin dries. Where there are many of these blisters, the leaves are destroyed, and the plants are consequently destroyed or much injured.

When the maggots are full-fed, the skin hardens, and they turn to brown or ochry oval pupæ (or chrysalis cases) in the leaf or in the earth; generally they leave the leaf and turn to pupæ in the earth.

The "miner" maggots go through their changes from the egg to the perfect fly so rapidly as to give time for two or more broods during the year. The fly is rather more than the eighth of an inch long, and about three-eighths of an inch across in the spread of the wings.

The colour is ochreous or brown, the eyes deep green, and the two wings are transparent and mottled with patches of brown. The poisers (that is, processes like a knob on a short stalk, which project from the body and take the place of the second pair of wings in the *Diptera*, or two-winged flies) are ochre-coloured.

They may be found in great numbers in the middle of May, and grub-blistered leaves may be found from the time the Celery is planted out till Christmas.

The maggots of the autumn brood turn to pupæ, and remain in the ground in that state during the winter.

Prevention and Remedies.—Something might be done in the way of prevention by attending to the ground on which infested crops have been grown (and which is almost certainly full of the pupæ):—The greater part of the maggots go down into the earth to change to pupæ, that is, to the little brown cases, out of which the fly will come up presently; these pupæ may be found in multitudes if the soil is turned up. Where there has been a bad attack, it would be a good plan to skim off the soil to a depth of about three or four inches, and burn it (if only a small quantity), or get rid of it thoroughly, with its contents, in any other way that may be preferred.

If this process cannot be carried out, the ground might be trenched, care being taken to turn the top spit into the bottom of the preceding trench, and so bury the pupæ too deep for them to develop and come up again as flies. Rough-digging might be of benefit, by placing some of the fly-cases within the reach of birds, and burying others in the same manner as in trenching. A more certain plan, however, would be to give the ground a dressing of fresh gas-lime, which, on being

"pointed-in," or mixed with three or four inches of the surface-soil, would destroy the pupæ; and sufficient time would elapse before the next crop was sown for the gas-lime to have gone through the chemical changes which turn it to a valuable manure. (See ref. to gas-lime in Index.)

The plan commonly recommended to get rid of the maggots, when attack is present, is to pinch them in the blisters; and this is good so far as concerns checking further attack from the next brood of flies which would have come from these maggots; but, with regard to the attacked plants, unless the pinching is very carefully done, it causes nearly as much damage to each leaf as the maggot itself. If it is simply crushed, it is all very well, but if a piece of the leaf is torn, or cut out, the damage is great from the operation. Care should also be taken to have infested leaves which have been removed from the plant, or refuse leaves with grubs in them, destroyed at once. The plan of throwing them on the rubbish-heap is especially bad in the case of this maggot. It has great powers of endurance; I find, by experiment, it will stand damp and mouldy surroundings, or, as a pupa, the extreme opposite of very dry ones, and come out in due time as the fly in perfect health.

The only certain way of destroying the maggots in the leaves is to burn them.

Sprinkling the leaves with a good coat of anything that is disagreeable to the Celery Flies (and so prevents them from egg-laying), and that will promote the healthy growth of the plants, is certain to be of use. A mixture of one part of unslaked lime, one part of gas-lime a month from the works, and two of mixed dry earth and soot, all well stirred together, and scattered liberally on the plants and the ground, has been found serviceable; and so also has been a dressing of soot, but this is not always successful.

During the bad attack of this Parsnip and Celery leaf-miner in 1883, Mr. John Speir, of Newton Farm, near Glasgow, wrote me, with regard to damage to Parsnips, that up to that time his usual remedy, or rather preventive, had been soot applied at the rate of 10 cwt. along the rows, which generally prevents both "Rust" and "Burnt leaves," but not so that year. The soot was applied about July 10th.

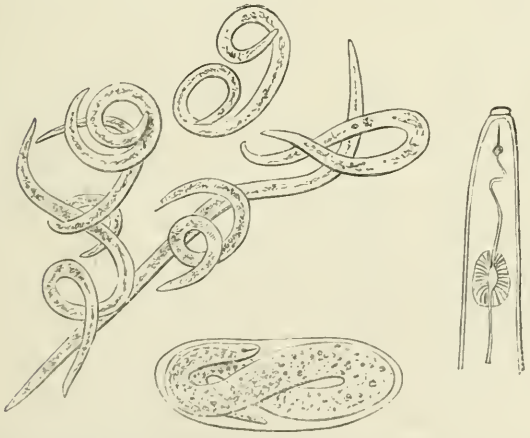
The damage from this leaf-miner infestation is caused by the plant being weakened by loss of leafage faster than it can make new growth to replace it; consequently a good start first of all is of importance, and a check at planting-out time is to be avoided. Any amount of manure, or water, or treatment of any kind suited to run healthy growth on rapidly, will be serviceable.

Celery being a plant that naturally grows in wet places, suffers from drought, and the Celery Fly thrives in dry weather. For this reason it is desirable, where practicable, to turn a good supply of water into the trenches from time to time. This makes the manure at the roots available, and the evaporation keeps a damp air round the plants very good for growth.

It is also of service to start with the garden-engine, or hose from water-supply, or large-rosed watering-can, at one end of the row, and send a good power of water strongly at the leafage, going regularly forward from one end of the row to the other. This clears off swarms of insect-vermin, which may be seen preceding the operator down the row; and if, whilst the leafage is still moist, any dressing that may be known to be serviceable is sprinkled over the leaves, it will adhere for a while, and be very useful in keeping off attack.

CLOVER.

Stem Eelworm. *Tylenchus devastatrix*, Kuhn.



Stem Eelworms (*Tylenchus devastatrix*): anterior portion of female showing mouth spear; and embryo in egg; all greatly magnified; anterior portion mag. 440 times. From figures by Dr. J. Ritzema Bos.

Clover "sickness" as it is termed, may arise from many causes, such as unfavourable weather, or nature or condition of soil being unsuitable to the plant; or from attack of fungus

or mould, but one chief cause is the presence of small eel-worms in the stems and shoots.

These eel-worms (*Tylenchus devastatrix*, scientifically) are too small to be observed without the help of a magnifier. At full growth the males and females are about 1-25th of an inch in length, the exceeding slenderness of their eel-like shape can hardly be conveyed by statement of measurement, but when magnified 200 times, so that they appear a little more than eight inches in length, their greatest magnified width hardly exceeds one-quarter of an inch. They multiply by laying eggs, and the eggs, young wormlets, and fully formed males and females, may be found in great numbers in the infested and misshaped stems and leaf-buds of the Clover.

From the circumstance of the stems and shoots being especially attacked by this *Tylenchus* the more serviceable name of "Stem Eelworm" is given to this special kind, and similarly the term Clover "Stem-sickness" is more useful for describing this disease than the general description of "Sickness" which includes all Clover ailments together.

For practical purposes the deformed growth of the "Stem-sick" Clover is quite sufficient to show the nature of the attack, the amount of deformation of course may vary with circumstances and season.

Specimens sent from Woburn about the middle of April, submitted to Dr. J. Ritzema Bos, Prof. at the State Agricultural College, Wageningen, Netherlands, one of the highest authorities on this attack, were reported on by him as follows:—"The stalks and branches were shorter and thicker than in the normal Clover plants; the buds particularly were much thicker, and some stalks and branches began to decay, or were dying. I found in these plants larvæ and adult nematoid worms belonging doubtlessly to the species *Tylenchus devastatrix*. In the buds I found them in considerable numbers." Early in July, in 1887, I had myself the opportunity of examining excellently characteristic specimens of "Stem-sick" Clover, also from Woburn. In this case some of the stems with flowering heads were still to be found, but also there were a large number of short barren shoots, about an inch long, oval in shape, and with the distorted growth of leaves then merely forming an imbricated, or "tile-like," exterior. These shoots were placed closely together, apparently from the growth of the shoot having been stopped. They varied in number; sometimes as many as five grew on an inch length of shoot, one at the extremity and two at each side below, so as to form together a flat, fan-like mass. I did not find they grew round the central stem. They were not all similar in form of diseased growth, but were commonly

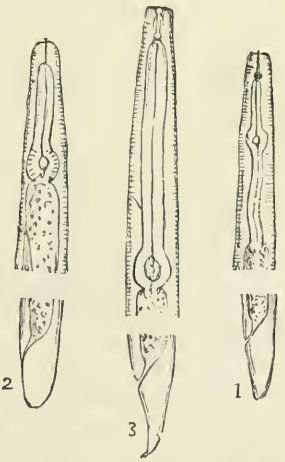
irregularly, and oval- (or somewhat bulb-) shaped; but sometimes they were much prolonged, so as to resemble what is known as a "duck-necked" Onion in shape, and sometimes the lower part of the flowering stem was enlarged for an inch or two at the base.

In some instances the short, brown, deformed shoots had a little bit of deformed shoot or of leaf-growth proceeding from it. One of the shoots, which was merely swollen, not altogether shortened by disease, on being opened, proved hollow near the base, with decayed matter within, and also palish brown powdery or rather damp granular matter, and on placing this under a one-inch object-glass it proved to be swarming with *Anguillulidæ*, or "Eelworms." Under a quarter-inch object-glass I clearly distinguished in some of these the presence of a *mouth-spear with a bulbous base*.*

These specimens were examined for me by Dr. Ritzema Bos, and by Dr. J. G. de Man, of Middleburg, likewise a well-known expert in the difficult study of these minute but very injurious wormlets, and were pronounced to be certainly cases of Clover Stem-sickness caused by the *Tylenchus devastatrix* found within. During the investigation of the last few years this special infestation has been found to be one of our regular attacks, but I give the preceding notes in detail to describe the precise appearance of an attacked crop.

It is not at all unusual to find various kinds of Eelworms feeding in the withering or decaying parts of plants suffering from *Tylenchus* attack, although these other species, as far as observations go at present, *never* cause the Clover "Stem-sickness."

One main point of distinction of these *Nematodes*, or "thread-worms," is the form of the *œsophagus*, or gullet, by which food is sucked into the wormlet. In some cases the mouth-cavity is furnished with a long process, called a spear, and in the *Tylenchi* this spear is placed on a trilobed bulbous base. The accompanying figure gives some idea of a few of the forms of the mouth-extremity of different kinds of *Nematodes*.*



Anguillulidæ: 1, *Tylenchus obtusus*; 2, *Aphelenchus avenæ*; 3, *Plectus granulosus*, real size microscopic. From figs. by Dr. C. Bastian.

* For details of the history of the *Tylenchus devastatrix*, together with excellent plates, see 'L'Anguillule de la Tige, *Tylenchus devastatrix* par

Prevention and Remedies.—Where Clover Stem-sickness is present, it has been shown, by the experiments of Mr. John Willis, at Rothamstead, that an application of a mixture of sulphate of potash 3 cwt., and sulphate of ammonia 1 cwt. per acre, had an excellent effect. This was applied April 3rd; the disease ceased and the Clover made a very vigorous growth, which was continued markedly in the second crop. Sulphate of iron, at the rate of 2 cwt., also answered very well, both in stopping the disease and causing good growth; but in this case the growth of the second crop was not quite so luxuriant as with the other application. Half quantity of sulphate of iron was less effectual in checking spread of *Tylenchus*.

Amongst the series of careful experiments tried for several successive years relatively to prevention or cure of *Tylenchus* attack in Tulip-rooted Oats, or "Stem-sick" Clover, the following mixture acted well:—sulphate of ammonia 4 parts, sulphate of potash 1 part, and steamed bones 2 parts; this was given at the rate of 1½ cwt. per acre, and was followed up by a dressing of 2 cwt. per acre of sulphate of ammonia. The result gave so luxuriant a growth that in little more than a fortnight after the second dressing the unhealthy plants, if any remained, ceased to be noticeable.

One very important point to be borne in mind in dealing with attack of this Stem Eelworm is that it infests many kinds of crop and weed-plants, and can pass from one to the other. This may be proved by sowing seed of plants liable to infestation on earth in which pieces of infested stem have been buried. This experiment I have myself tried, and on the broad scale of field cultivation I have notes of Clover-plants, "Stem-sick" from this Eelworm, occurring on land where Tulip-root had been bad in Oats the previous year, and of Tulip-rooted Oats occurring on land where the Clover had been "sick" the previous year.

It is highly desirable, where there has been Stem Eelworm-attack, to take as the next crop something which is not known to suffer from it; and amongst the crops which are especially liable, as Oats are in this country, to attack of the Stem Eelworm, *Clover should never succeed Tulip-rooted Oats, nor Oats Stem-sick Clover.*

The Eelworms have the power of leaving the infested plants, and lie near the surface of the ground; therefore ploughing with a skim-coulter so as to turn the surface thoroughly well under and to leave it there is a good remedy; but common

Dr. J. Ritzema Bos.' Also in my 13th Report on Injurious Insects (Simpkin & Co., London) I give a digest of our English observations up to date, with a plate showing male and female *T. devastatrix* and eggs, taken, by kind permission, from drawings by Dr. Ritzema Bos.

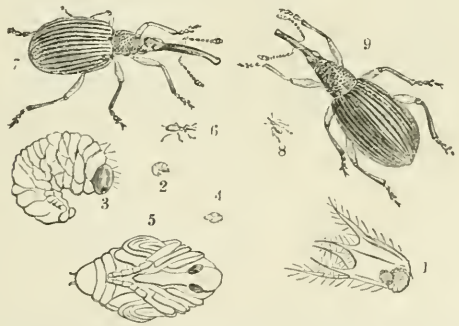
ploughing or digging which only breaks up the surface and scatters it about is probably hardly any good at all.

It is also to be remembered that this *Tylenchus* can survive the operations of digestion in animals fed on fodder infested by it. Therefore, if manure made from infested fodder is carried out to the fields, the very identical Eelworms will in all likelihood go back again to cause new mischief.

For further notes on attack of this *T. devastatrix*, crops and plants attacked by it, and various measures of cultivation by which the attack may be met, see paper on "Tulip-root."

Clover "Pear-shaped" Weevils.

Apion apricans, Herbst, = *A. flavifemoratum*, Kirby; *A. assimile*, Kirby.



6, 7, *Apion apricans*; 2—5, maggot and pupa; 8, 9, *A. assimile*; —all nat. size and magnified; 1, maggot feeding, magnified.

Apions, or "Pear-shaped Weevils" are very small beetles with an oval body, to which such a long arched proboscis is prefixed that the whole insect has much the form of a long-stalked pear, whence its name.

There are many species, some of which do great injury to Clover; the two kinds figured above are common on the Red or Purple Field Clover, *Trifolium pratense*. To the naked eye both kinds are black or metallic-black, with the lowest joint of the horns, all the thighs, and the shanks of the front pair of legs of a yellowish colour, or some shade of brown or reddish. In the *A. apricans* (*subfemoratum*, Kirby) these portions are described by Curtis as lighter or yellower than in the other species, and there are other differences, but these are so slight that at one time the two kinds were considered to be mere varieties; and there is a third kind (the *A. trifolii*), which is very like the above both in shape and colour, which is said to occur sometimes in large numbers on Purple Clover.

The *Apion apricans*, more especially known as the "Purple-Clover Weevil," may be generally described as follows:—Black; proboscis curved. Horns black, with base of a brownish yellow, and placed near the middle of the proboscis. The thorax or fore body cylindrical, smaller before and punctured. Head punctured, channelled between the eyes. Wing-cases furrowed, with convex space between the furrows, and the furrows punctured. Legs partly black, but all the thighs, the shanks of the fore legs, and some of the smaller upper portions yellow or reddish yellow. The maggot is of the shape figured at 3, magnified, dusky white, with a reddish horny head.

The life-history is thus described by Dr. E. L. Taschenberg:—When wintering time is past the beetles pair; after this the females lay many eggs in the blossom-heads of the Clover. The larvæ, which soon hatch from these, feed on the still unripe seeds and seriously injure the production of Clover-seed. The maggot-infested plants may be easily known by the rapid withering of the heads. By the time of first cutting of the Clover the larvæ are full-grown and turned to pupæ at the bottom of the flower, between the dried-up blossoms of the heads."*

From these chrysalids the weevils come out in about a fortnight, or, in the case of autumn broods, may remain in chrysalis state till spring. As the stages of their life-history are gone through rapidly, there may be several generations in one year; the pests stored as maggots or chrysalids with the harvested Clover will produce swarms of weevils to come out and attack the blossoms of the second crop, and so continue their generations, weather and crop permitting.

In specimens sent to myself the attack was present in the second crop, in one instance doing great harm to about fifty acres of seeding Purple Clover, and similar mischief was then being done to a serious extent near Bridgwater and West Buckland, Somerset. I found the little whitish maggots at the base of the florets just as described.

Prevention and Remedies.—When the maggots are feeding in the forming seed, which may be known by the rusty or prematurely withered appearance of the flowering heads, nothing can be done to save the seed crop, and the best that can be done is to mow the crop as soon as possible for hay.

As a preventive measure the only thing which it seems possible to do is to lessen the amount of weevil-presence in the neighbourhood beforehand; and as the points of this

* 'Praktische Insektenkunde,' by Dr. E. L. Taschenberg, Part II., p. 181.

treatment have been so well given many years ago by M. Herpin that it is hardly possible to state them more clearly, I quote them from the translation in Curtis's 'Farm Insects':—

"1st. Cut early and feed off (while green) the Clover crops which are known or supposed to be much infested by the *Apion*.

"2nd. Carefully avoid allowing the Clover crops to remain more than two years in succession on the same ground.

"3rd. Avoid also allowing the Clover which is much infested by the weevil to ripen and run to seed.

"4th. Alternate and vary the culture."

The 5th suggestion is that if the Clover is stacked green, and subjected to a sufficiently high fermentation to turn it brown, the maggot contained in it will be destroyed. At the present day the use of the silo would assist in this case.

Where infested Clover is stacked in the common manner great numbers of weevils escape from it, and very probably something might be done to kill these by throwing quick-lime or gas-lime on them. When they are in such numbers (as has been recorded) that there are scores on one plant, and they are regularly sweeping on from the stack from which they started, something might be done to get rid of these hordes. It is mentioned by John Curtis that the weevils are soft and tender in the chrysalis state, and this I had an opportunity of observing in the specimens sent to myself.

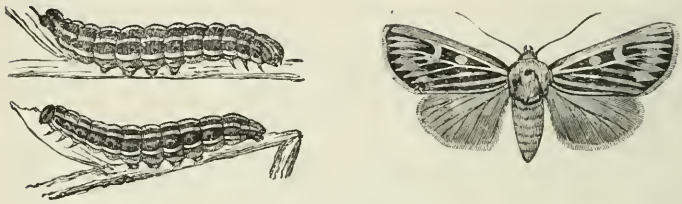
When properly developed, the Purple-Clover Weevil has a powerful pair of wings, but in those which I examined, which developed in captivity, in a closed box filled with Clover-heads so that there were no favourable circumstances for expansion, most of the wings were abortive, or not properly formed. Where this is brought about in farm practice by the above-mentioned methods of stacking or otherwise, it would be a great check on spread of the pest.

The measures suggested by Mr. Whitehead, of feeding off infested plants in autumn by folding sheep on the leys and likewise of burning refuse Clover-heads after threshing, could not fail to be of service.

For paper on Clover *Sitona* Weevils see "Pea, Bean, and Clover Weevils."

CORN AND GRASS.

Antler Moth, or **Grass Moth.** *Charæas graminis*, Linn.



Antler Moth (*Charæas graminis*) and caterpillars.

The attacks of the caterpillars of the Antler Moth are remarkable for only occurring occasionally, and especially in mountainous districts, and for these appearances being in such vast numbers, and over such a large extent of country, as to be an amazement to all not acquainted with their habits. Such an attack occurred in June of 1884, in the mountainous part of Glamorganshire, extending over an area of about ten miles of the country lying west of the Rhondda Valey, and such an attack occurred again in the summer of 1885 in Selkirkshire, N.B., destroying in its course some of the hill pastures in Ettrick and Yarrow.

The above figure gives the size and method of marking of the Antler Moth and caterpillar. With regard to colour, the moths are variable, but may be generally described as having the fore wings of various tints of brown, with somewhat pale or white antler-shaped markings, from which the moth takes its name. The hind wings are brown or greyish brown. The caterpillars are marked with dark brown, and pale streaks running lengthwise; the head is brown or yellowish. The life-history is stated to be that the eggs are laid by the female moths about the middle of summer; these hatch in about three weeks, and the caterpillars are then said to hide themselves by day and feed by night: they live through the winter, and in spring again begin their destructive operations. These continue till about June, when they go down into the ground to turn to chrysalids, from which the moths come out to lay the eggs, as above mentioned, in July and August.

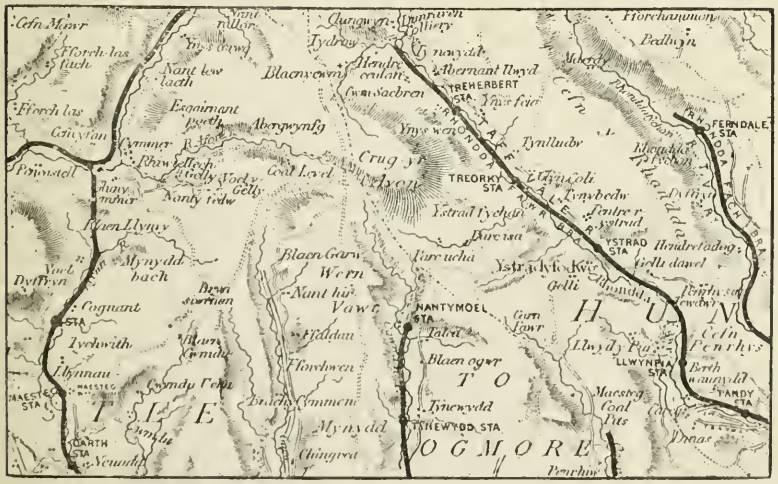
No detailed reports were forwarded as to the parts of the grass which were devoured by the caterpillars in either of the above attacks, beyond the general fact of the pasture being devoured; but, with regard to this important point, it is stated, in Curtis's 'Farm Insects,' pp. 506, 507, that "they

live on the roots, and eat away all shoots." In 'Kollar on Insects injurious to Gardeners, Farmers,' &c., p. 137 (English translation), it is stated:—"The food of the caterpillar consists of all the soft parts of grasses. It lives at the roots, and eats all the germs. Although it is in existence in autumn, it lies benumbed in the earth in winter, and begins to eat again in the spring; yet the effect of its devastations appear chiefly in the beginning of June, when it has changed its skin for the last time."

Kaltenbach (another good German authority) places the Antler Moth amongst the insects infesting Wheat and Rye, and, under the head of Barley, notes that the caterpillars live at the roots of various kinds of cereals, to which they are destructive; and Linnæus stated the Antler Moth caterpillars to be "the most destructive of Swedish caterpillars, laying waste our meadows, and annihilating our crops of hay."

The extent of spread of the Scottish attack was shown on a map forwarded at the time by a line enclosing an area of about seven miles by five miles, lying in the west of Selkirkshire, with Ettrick Water running down the middle.

The accompanying map will show the mountain ground and large area over which the summer attack of 1884 extended in Glamorganshire.



District of Glamorganshire attacked by caterpillars of Antler Moth (Photo etched from Cruchley's Tourist's Map).

Scale of English miles. 1 2 3 4 5

The north-east side of the Rhondda Valley, which is the most easterly limit named, lies some ten or twelve miles N.N.E. of Bridgend, and it will be observed from the following account that the attack extended thence westward past the Ogmore Valley and the Garw River to Maesteg, the most westerly limit named, and that the large extent over which the smoke of the mountain fires was seen showed the caterpillar-presence spread widely on a scale requiring strong measures to check it. Altogether the area of the attack taking the diameter from W. to E. does not appear to have been less than ten miles.

The account forwarded to me on the 18th of June mentioned that on the mountains of Ystrath-y-Fodwg (hills about ten miles north of Bridgend, in Glamorganshire) myriads of caterpillars were devouring every green thing, leaving the mountains brown behind them.

It seems they were first noticed on Bwlch-y-Clawdd, a lofty ridge separating Cwm Park from the Rhondda Valley; but on Sunday (the 15th of June) it was found that they had attacked, or rather were attacking, also the north-east as well as the west side of the valley. At Treorky Station (a station on the Rhondda branch of the Cardiff and Merthyr Railway) the mountain brook running from the Fforch Mountains was thick with myriads of these caterpillars, which had been drowned by falling into it during their march across the side of the mountains. The Ystrad side of the Bwlch-y-Clawdd Mountains above Cwm Park were "brown, as the result of recent fires ignited with a view to destroy the pests." Near the summit the insects were observed, which moved down to the mountain-path from the burnt herbage with extraordinary rapidity. Some of them were secured, and (as above mentioned) specimens from the hordes were sent to myself for examination.

On proceeding some miles towards Maisteg, leaving the Ogmore and Garw Valleys on the left, everywhere caterpillars were swarming, and a large hole in the peat was observed in which thousands of the caterpillars had fallen and died. The Maindy and Bwllfa Mountains were alive with them, and, standing on the ridge above the Ogmore Valley, the smoke of the mountain fires was to be seen to the west, where attempts were being made to destroy the pests.

Further details were given in the preceding and in other accounts, of which the main points were—the great area attacked and the damage done; the necessity of burning the surface to destroy or drive away the caterpillars, and likewise the vast numbers found drowned where there was water to fall into; and also the quantities of rooks or crows which flocked to the infested area.

All these points coincide with what has been reported of similar attacks elsewhere, as, for instance, one which occurred at Clitheroe, in Lancashire in 1881 (in which, as far as could be judged from caterpillars only, the nearly allied species of moth of very similar habits, the *Heliophobus graminis*, was also present); likewise a great appearance on Skiddaw, in Cumberland, in 1827, and on the Hartz Mountains of Germany, in 1816 and 1817, but, as I am not aware of the geographical area of an attack ever having been so minutely recorded, and it is rare in our country to have instances of devastation on such a widespread scale, it has appeared desirable to note the occurrence at length, with the map accompanying.

The only available remedy for attack on this vast scale appears to be the one made use of, namely, firing the surface, and thus getting rid of great numbers of the caterpillars amongst the burning grass and heath, and other mountain plants which would help to feed the fire.

The habit of the caterpillars of going right onwards, whether into streams, standing water, or otherwise, together with their activity in crawling in bodies away from the fired ground, might very possibly be utilised to direct the course of some of the hordes into a stream or other convenient end.

On a moderate scale of attack it has been found to answer to turn pigs on the infested land, or plough the surface to turn the grass roots up with the caterpillars amongst them for the pigs to clear.

Corn Aphis, Dolphin, or Plant-louse.

Aphis (*Siphonophora*) *granaria*, Kirby; *Aphis avenæ*, Fab. ?

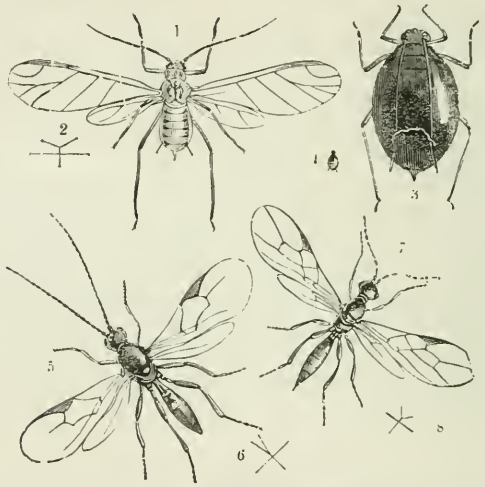
This Aphis is to be found on Wheat, Barley, Oats, and Rye, and is sometimes very hurtful.

Early in the summer the Aphides may be found sucking sap from the leaves or stems of the young plants, but later on they attack the ears, inserting their suckers close to where the grains spring from the central stalk of the head. Sometimes as many Aphides are found as there are grains in the ear, sometimes the ear is choked with them, more than two hundred having been counted at once.

The injury is caused by the Plant-louse drawing away the sap with its beak or sucker, and thus not only exhausting the strength of the plant, but also causing much injury to the tissues by means of the many minute punctures.

When the ear begins to harden, so that the Aphis cannot drive its sucker in, then the grain is safe from further injury.

The wingless viviparous females are described as green or brownish green, with brown horns, and the horn-like tubes at the end of the abdomen also brown; the eyes red. The winged viviparous females have the abdomen green, and the rest of the general colour pale brown, or rusty yellow; the tubes on the abdomen (cornicles) black; eyes red. The wings are green at the base, with brown veins, and the spread of the wings is about a quarter of an inch or rather more. In its earlier stages the Plant-louse is green; the pupa has a more golden tint in autumn, and its wing-cases are pale brown. (Mainly from Mon. of Brit. Aphides.)



1—4, winged and wingless Aphides (*Aphis granaria*), nat. size and magnified (3 and 4 discoloured from attack of parasite fly); 5 and 6, *Aphidius avenæ*; 7 and 8, *Ephedrus plagiator*, parasite flies, nat. size and magnified.

Empty skins are often to be found amongst the other Aphides, differing in being somewhat swollen, wingless, and brown in colour (see above figs. 3 & 4). These are Aphides which have been destroyed by the maggot of a parasite fly feeding within them.

In the year 1885, damage from infestation of Grain Aphis was unusually prevalent, and was reported to me from various places, extending from Fife, in Scotland, down to Kent,—but the observations were mostly across the northerly or north-midland part of England (Cheshire to Lincolnshire).

By careful examination of the specimens sent, a large proportion of which reached me alive and unparasitized, it appeared that some were of the Common Grain Aphis, the *Siphonophora granaria*, Kirby, but by far the larger proportion

of the great numbers sent me were entirely brown throughout all their stages, and without any of the green in the early stage, or partial amount of green in the winged specimens, which is characteristic of the true *S. granaria*.* They corresponded more with the *A. avenæ*, Fab., of which some short description is given in Curtis's 'Farm Insects,' p. 500, and leave the matter consequently in doubt whether this so-called "Oat Aphis" is not a true, distinct species; or, again, whether these dark Aphides sent me were only a variety of the variable common *S. granaria;* or, again (following the conjecture sometimes brought forward), whether there is a change of colour in the insect with the change of food,—from green whilst feeding on the leaves or stem, to the brown colour when it has settled in the grain.

Prevention and Remedies.—Dusting with lime, whilst the Corn is still young and the Plant-lice spread about on it, has been suggested as useful; and soot would be likely to do good, it being a fertilizer, as well as disagreeable to the insects; but probably a dressing of any kind of manure that would encourage healthy growth would be best. The nature of this would depend on the soil, and state of the crop.†

It has been noted that, when the crop was late, it suffered severely; when early, it suffered less; whether this is always the case does not appear, but it is likely, partly from the leaves and ears having passed the soft, delicate state in which the Plant-louse can pierce them with its sucker, before the insect appeared to attack them, and partly from the larger and more vigorous plants being better able to bear attack than the young ones.

In a leading article of the 'Gardener's Chronicle and Agricultural Gazette' for August 15th, 1868, it is remarked:—"The Plant-louse in the hot summer of 1864 was, and is again during the present hot season, a great pest. It mostly affects the later Wheats, which in some cases are covered with hundreds of these creatures, which can only live by sucking out the juices from the ear; hence early Wheats are

* The following is a short general description of specimens forwarded from Tabley Grange, Cheshire:—The youngest forms or "lice" were fawn or brown. The pupæ brown or chestnut-brown, with the fore body paler, and with a greenish tint; the wing-cases (which are at this stage appendages like little fins or flattened spikes laid on the sides), were pitchy-black down the middle; the honey-tubes pitchy. Winged specimens: Fore body chestnut or somewhat yellow-fawn; abdomen of a darker shade of chestnut, and eyes dark chestnut. Wings glassy, not quite transparent, with yellowish nerves.

† This would appear to be precisely a kind of attack which (until the Corn grew too high) might be advantageously treated by fluid dressing, thrown by the air-drill popularly known as the "Strawsonizer." The drenchings would greatly injure the Aphides, and would push on a good growth of the plants.

mostly too dry to be injured at the time when the creatures are developed in sufficient numbers to be mischievous."

In an extremely bad outbreak of this Aphis on one hundred and ten acres of Wheat, in Cheshire, during the wet summer of 1879, the Wheat was March-sown, and was about six weeks later than in average seasons; and in the middle of September every *green* head in the field was blasted by them.—(S.L.)

In another instance recorded the infested ears were noticed as tapering from the middle upwards, and it was found the upper half was mainly infested by the Aphides, this apparently from being rather less advanced, and consequently softer.

The various observations point to any method of cultivation or date of sowing being desirable that will get the plant on in good time, ahead of the main appearance of this kind of Aphis.

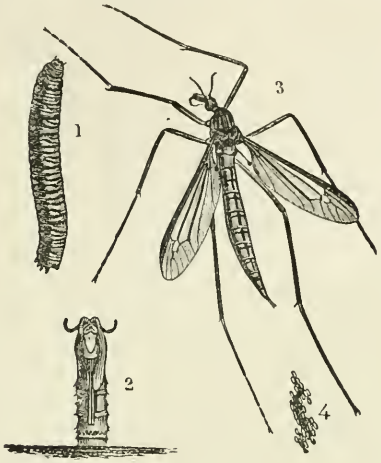
How this Aphis passes the winter in this country is not clearly known, but it has been observed by Dr. C. Thomas, late State Entomologist of Illinois, U.S.A., that when winter Wheat appeared above ground in the autumn, the Aphides appeared on it. He says:—"Here they work upon the leaves and stalks singly while the weather is not too cold, but when winter appears they move downwards towards the ground, some of them at least entering the soil and feeding upon the sap of the roots; at any rate I find the apterous ones at this time working upon the roots, but at the same time I find a winged individual above ground. I have also observed them heretofore at the root of the Wheat late in the winter, while snow was on the ground, and what somewhat surprised me, I found them busy at work under the snow, and the apterous (wingless) females bearing well-formed larvæ. I am therefore led to believe that in this latitude the species passes the winter *in other than the egg state.* This will also probably be found true wherever winter Wheat is grown." *

This Aphis has been recorded as infesting all our common Corn crops, and many of the wild and cultivated Grasses. It would appear, therefore, that such thorough cultivation of the surface of the ground as would clear out any roots whether of crop or weed Grasses in which the Aphides could shelter, might be very serviceable, before putting in Wheat.

The habit of sheltering in wild Grasses would quite account also for the appearance of the insect in spring or early summer on Corn growing near such shelters, and destroying headlands and breadths of wild grass would do good.

* 'Third Annual Report on Noxious and Beneficial Insects of the State of Illinois,' by Dr. C. Thomas, pp. 53, 54.

Daddy Longlegs. *Tipula oleracea*, Linn. (and other species).



Daddy Longlegs (*Tipula oleracea*): eggs, grub, and chrysalis.

The flies commonly known by the name of Daddy Longlegs, or Crane Flies, which develop from the grubs known as "Leather-jackets," are to be seen in multitudes, especially in autumn, in neglected grassy spots, meadows, and Clover-leas, and also on marshy ground, where they deposit their eggs, and are the cause of enormous damage to Corn and many other crops both of garden and field, in consequence of the grubs gnawing the young plant just below the surface of the ground, and thereby destroying it totally or lessening the yield.

The female *Tipula oleracea*, lays her eggs (mainly during autumn) in the ground, or on the surface, or on damp grass or leafage close to the surface of the ground. These eggs are small, black, and shiny, so small and so numerous that as many as three hundred are to be found in one female, forming a mass which occupies nearly the whole of the abdomen.

The grubs which hatch from these eggs are cylindrical, legless, wrinkled across, of a dirty greyish or brown colour, the tint of which may vary considerably; I have seen them of a deep blackish colour when from peaty land. When full-grown they are about an inch to an inch and a half long, and about two-thirds of the thickness of a common pen-quill. Their little black horny heads, which can be protruded at pleasure, are furnished with a pair of strong black jaws, and bear a pair of minute horns; the tail-extremity is cut short off, and bears four tubercles above and two below. From the great

toughness of the skin the grubs are often known as Leather-jackets.

The grubs change to the chrysalis state (under the surface of the ground, or under the protection of weeds), and in this condition the form of the future wings laid down on the breast, and of the legs laid along beneath the body, are observable. The abdomen is furnished with spines, by means of which the chrysalis pushes itself on until it stands about half out of the ground (see "2" in figure), the horny covering presently splits, and leaving the empty case standing upright, with the hole in it through which it has escaped clearly shown along the back, the Crane Fly or Daddy Longlegs comes forth, spreads its legs and two wings, and appears as seen at fig. 3. These flies appear chiefly towards the end of summer.

Besides the species known as *Tipula oleracea*, of which the tawny brownish appearance is well known, there is a smaller kind, of a yellow colour, spotted with black, known as *T. maculosa*, or the Spotted Crane Fly, and another larger kind, known as *T. paludosa*, or the Marsh Crane Fly. These two kinds are hurtful to the crops in the same manner as the common Daddy Longlegs, and require the same methods of prevention.*

Prevention and Remedies.—The points to be especially attended to are:—

1st. Any measures tending to lessen the quantity of eggs laid.

2ndly. Methods of cultivation which will destroy the egg or the grub in infested ground.

3rdly. Such applications of manure as may push on vigorous growth from the first sprouting of the seed, and also such special application in case of attack as may act rapidly—that is, be carried down at once to the roots, and thus invigorate the growth and carry it through the season when it is suffering from part of the supplies being cut off.

1st. *Measures tending to lessen quantity of eggs laid.*—The parent fly frequents damp meadows, neglected herbage, and shady spots, such as are to be found by hedges and strips left at the sides of cultivated fields; and also under the shade of trees in open fields.

Rough-mowing neglected ground, and then collecting and burning the mixed grass and tops of weeds, would destroy a deal of shelter; and in meadows bush-harrowing is a good plan to lessen egg-laying. It disturbs the shelter in which the flies prefer to lay, and exposes many of the eggs.

* For good descriptions of *T. oleracea* and *T. maculosa*, in perfect and larval stages, and other useful information on the subject see Curtis' "Farm Insects."

It may be noticed, in crossing a large space of grass-land in autumn, that where the ground is dry and the herbage short, there are few of these flies to be seen; whilst on the same land, with only the difference of shade or some cause for longer growth of herbage, they will rise in numbers before the passer-by.

Penning and hand-feeding sheep on spots where the grass was not thoroughly eaten short would be a sure preservative. The biting of the sheep would clear off the shelter for the fly, and the trampling and general state of the surface consequent on their droppings would stop all oviposition.

Autumn top dressing would encourage, *or deter*, attack, according to material employed. Farm-manure would only make an agreeable shade or shelter for egg-laying purposes in or around the lumps; whilst, on the contrary, a dressing of gas-lime and lime mixed would probably have a very deterring effect.

Where the land is so damp that the Daddy Longlegs are present in most years to a hurtful extent, the ground should be drained.

Rooks are sometimes very useful in lessening amount of the flies. Special observation of a flock of Rooks on ground much infested showed they would catch and swallow the flies at a rate of four a minute.

2ndly. *Measures of cultivation which will destroy the egg or the grub in infested ground.*—The grub is to be found most plentifully after a wet autumn, because this state of weather suits the flies (and in such circumstances the green crops are also suitable for oviposition, as well as the meadows and grassy spots which are most frequented in ordinary years), and also because the continued wet does not allow of the land being thoroughly cleared of surface rubbish.

Daddy Longlegs grubs may be found as early as February (as during 1880), when they were destroying hundreds of acres of autumn-sown Wheat on heavy land after Clover, round York at that date. Sometimes, as in the winter of 1883-84 preceding the severe attack of 1884, the autumn hatched grubs are advanced enough to sweep off autumn Wheat in December, and to continue actively through the winter; the regular work of destruction, however, usually commences later,—about the beginning or middle of May,—and continues till the end of June, or even to the beginning of August. Much will depend upon the state of the weather, the character of the soil, and the condition of the plant at the date of attack, as to the amount of damage which the farmer will have to sustain.

The flies and grubs may be found throughout the summer,

but for the most part the grubs change to the pupa state, in which they can do no further harm so far as eating is concerned, from July to September.

Breaking up pastures and Clover-ley so early in the autumn that the Crane Flies only find dry bare land unsuitable for egg-laying, is a good treatment where the ground can be spared, and deep ploughing of leas or old pasture is a good practice, so as to bury the eggs and grubs deep in the soil. The absence of heat and air in the first case prevents or retards the hatching of the eggs; and in the second, some of the grubs are killed, and many are injured by the unnatural surroundings and want of food.

A dressing of gas-lime on the pastures before breaking them up would prove especially serviceable. If it was applied in a fresh state the noisome smell would deter the fly from laying eggs, and the poisonous matter it contains would destroy the eggs already deposited, or the larvæ present in the soil. There would be ample time before seed-sowing for the necessary changes occurring to turn the deleterious substance into a safe manure.

Paring the surface and burning it with the grubs contained in it has been much resorted to, but the practice is open to some objections; also it usually requires extra labourers, and it causes delay in cultivation, which is especially inconvenient in the north, where the climate allows little spare time in getting the leas ready for seed.

Thorough cultivation such as would break up, or bury, or tear to pieces, all the clods of earth, tufts of grass, and other rubbish that the grub shelters in, or feeds on till the new crop is ready for it, is important, joined to such manuring as may be best suited on each different kind of soil to press forward the plant-growth. Attack in the early stage of growth, at the time when the food-stores in the seed are just used up, and the plant is beginning to depend on the first rootlets, is particularly to be guarded against, as a check sustained at this *first period* of growth is likely never to be entirely got over. Therefore such treatment as will cause a rapid healthy growth after sprouting will be found a good preservative, rather than a state of soil which will allow only of the plant slowly struggling forward, exposed for a much longer time in its weakest state to attack.

It is on cold wet land in general that this grub is most destructive, and it has been observed that it is upon the damp and clayey parts of a field that its attack is worst. The seed germinates more slowly on the colder soil, and the same amount of cultivation which is enough to put the rest of the field in good tilth is not sufficient to prepare an equally good

seed-bed on this. The plant takes longer to develop, the growth is slower, and consequently, as it is not able by its growth to counter-balance the effect of the damage from the grub, it starves, sickens, and dies.

Well-drained ground, properly prepared, and plenty of suitable manure,* are the things most likely to keep off attack; and with a special view to lay a foundation for strong growth where an attack is feared, it is recommended to use guano as a top-dressing, along with the seed. This more particularly applies to clay-land, as the ammonia contained in guano is especially wanted on these soils.

3rdly. *Applications that are of use when the grub is destructive to the growing crop.*—With regard to *mechanical* applications. The grubs pierce the soil by means of their pointed heads, and draw themselves through by their rings; and therefore, though it is but an imperfect cure, something may be done by compressing the ground so that they cannot easily stray about under the surface, and waste and weaken even more than they totally destroy.

Pressure may be given by a Crosskill's roller or a Cambridge ring-roller, and where the land has been previously rolled so that no shelter is afforded to the grub a good many may thus be crushed. Where there is bad infestation, it would be worth while to examine whether the grubs are out on the surface at dawn and dusk, and if so, though rolling at such times is exceedingly inconvenient, it would be the best time for the operation. The grubs may sometimes be collected by a top-dressing of Rape-cake, and the roller passed over the ground in the morning with good results. In a series of experiments tried in 1884, by Mr. Ralph Lowe, of Sleaford, Lincolnshire, with regard to the amount of weight which could be borne by these Leather-jacket grubs, he placed some of them in moderately damp soil, about an inch from the surface, and applied a pressure of 2½ cwt. for five minutes. The soil was pressed very close, and the grubs, on being *exposed to the air*, soon recovered.

Repeating the experiment for the same length of time—that is, five minutes—with the lesser weight of 2 cwt., but *leaving the grubs in the compressed soil*, it was found that forty-eight hours afterwards none of them had moved, and Mr. Lowe considered they would not have moved, but died where they had been pressed down.

The above experiments appear to me of value in con-

* Daddy Longlegs grubs are sometimes carried out to the field in farm-manure, and are also to be found in composts that are mixed with decaying turf; such applications therefore need inspection where there is reason to suspect infestation, and most especially in the case of rotten turf heaps.

firming and showing the method of action of one of the accepted methods of lessening the ravage of Daddy Longlegs grubs.

Hand-hoeing and horse-hoeing are noted as remedies, the former being preferable, as it disturbs the working of the grub, and kills some, whilst it exposes others to the birds; at the same time this is "a dear remedy for a bad attack," as the grubs lie so close in amongst the roots of the plants. In a bad attack on a twenty-acre field of Peas, the outlay was at the rate of 4*s.* to 5*s.* 6*d.* per acre for five hoeings.—(E. A. F.)

The following applications have been found useful in cases of bad "Leather-jacket" grub presence:—

In a case of very severe attack on a twenty-acre field of Oats belonging to Mr. D. Byrd, of Tarporley, Cheshire, a mixture was applied at the rate per acre of guano 1½ cwt.; kainite 1 cwt.; superphosphate 1 cwt.; and salt 2 cwt. This was applied about the 10th of May, the harrows followed the manure drill twice, and a heavy Cambridge roller was taken two or three times over the whole field at the time. When this was given it was estimated that fully half the crop was taken by the grub; but the application brought the field round so, that at last the crop was estimated to be forty to forty-five bushels the acre; in Mr. Byrd's words, "the crop restored, minus the cost of manure."

Guano has answered as a dressing, and guano and salt mixed applied at the rate of four hundredweight per acre, in the case of a very bad attack of grub on Oats, after Clover, was found perfectly successful in checking attack and running on a good growth, resulting in a fine crop, when all other means to stop the ravage had failed.—(S. F.)

With regard to the action of salt: probably it does some good by driving the grub down; but, as an application by itself, it has failed in many cases. As a dressing at the rate of seven hundredweight per acre to a grub-run field of twenty acres, it did no good.—(J. H. W.)

Special experiment, by applying salt on three occasions to a number of Cabbages, planted in pots and healthy, before the grub was introduced, showed *that even with a quantity that killed the plants*, the grubs were to be found at increased depths below the surface, these depths apparently regulated by the amount applied; but the grubs were in no way the worse.

It was found that the grubs might be immersed in strong brine for twenty-four hours without being killed.—(R. S.). In other experiments conducted by Mr. Ralph Lowe, previously quoted, "brine was tried at a strength of one pound of salt to a quart of water, and the grubs dropped *into* it died in a short

time ; those on which the brine was merely poured were none the worse." From these observations it appears that salt cannot be trusted to as a means of killing the grub, and in very wet weather when the rain washes it down quickly, it is probably of little or no use ; but in moderately dry weather it may be of some service in keeping the grubs from straying about on the surface, as it annoys them.

Nitrate of soda acts well, both by benefiting the plant and injuring the grub. In experiment tried by myself I have found immersion of the "grub" in a solution of the nitrate to be followed by an immediate and violent discharge from the intestines.

Amongst the experiments tried by Mr. Lowe he placed grubs in earth at a depth of within one inch of the surface, and covered the surface above them respectively with an amount of salt representing 1 ton per acre, lime 3 tons per acre, and nitrate of soda 2 cwt. per acre. These were watered with rain-water until the soil was well saturated, and "the effect in salt and lime was not perceptible. The grubs treated with the nitrate of soda were very relaxed, soft, and helpless" ; and eight days after Mr. Lowe wrote that they still continued limp and helpless. This helplessness is a very important point, for thus the grub, instead of creeping away, is kept under the action of the solution good for the plant but bad for itself, and ultimately dies.

An application of 1 cwt. of nitrate of soda to Barley as soon as well above ground had an entirely satisfactory result on land where the previous crop had to be ploughed in consequently on grub ravage.

With regard to effect of cold, I was permitted to have some specimens frozen by artificial means, at Kew Observatory, down to a temperature of—10°, that is, ten degrees below zero, or forty-two degrees of frost ; and although most of the grubs died, yet it showed that the grub could exceptionally survive even this temperature, to all appearance quite uninjured.

The grubs have been noticed frozen until quite brittle, and yet when thawed they were perfectly active.

With regard to power of bearing immersion, I found by experiment that although the grubs appeared to be dead after remaining in water for about fifty-eight hours, yet that they recovered after being exposed to the air ; the exact time at which life was destroyed after being replaced in water was difficult to tell, but the whole time they lived from the beginning of the experiment might be considered about four days and nights ; it certainly did not exceed five days and nights—that is, one hundred and twenty hours, for the grubs then burst.

The above experiments point to the fact that frost will not rid us of these grubs, and also that flooding land to get rid of them is not likely to be of much use unless the water is mixed with some ingredient injurious to the grub, and is flooded on to the land so completely and for so long a time that the grub has no chance of escape. Where a field can be treated in this way, the plan has been found to answer well close to sewage-works.

With regard to want of food, some of the grubs placed in a vessel with a little earth, but no food-plant, were found to be alive and perfectly healthy after about three weeks; how much longer is not mentioned.—(S. F.)

Under drought, however, as far as experiment shows, the grub rapidly fails.

Methods of prevention and remedy of this infestation may be said to lie in carrying out so far as can be done the following principles :—1stly. Drainage, and clearing away all unnecessary amount of wet neglected herbage; and such treatment of rubbish in the fields as may prevent it serving for food or sheltering places. 2ndly. Giving the plant a good start, and keeping up a healthy growth by ordinary measures of good cultivation and manuring; and 3rdly, in case of attack, although mechanical measures, as rolling, hoeing, &c., are of some service, mainly depending on such fertilising application as will be available at once to the plant, and keep up its strength by the extra supply of food.*

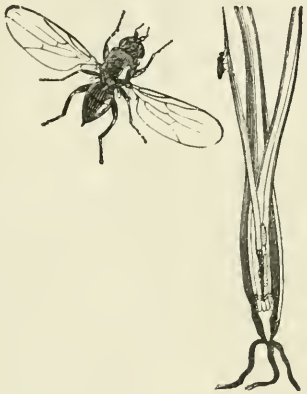
Frit Fly. *Oscinis frit*, L. (*? Oscinis vastator*, Curtis).

The Frit Fly is a small, black, shining, two-winged fly, rather under the eighth of an inch in length. "Legs black, the tarsi (feet) of the hinder pair, with the exception of the end joints, yellow; the fore feet brown-yellow, the midmost often much darker; the wings transparent, somewhat brown at the fore edge."† It is also distinguishable by its peculiar habit of dancing or skipping about, which has been very noticeable in the specimens I have reared. This fly is common in various parts of the Continent, and especially recorded as

* Many of the measures regarding treatment of land, and manuring, mentioned in paper on Wireworm, would be also serviceable for prevention of Daddy Longlegs infestation. Special information on this attack and methods of prevention will be found in my Reports on Injurious Insects for 1880; 1883; and 1884.

† For description of the "Frit Fly," see 'Fauna Austriaca, die Fliegen,' by Dr. J. R. Schiner, ii. Theil, p. 224; and for description in all its stages, with life-history, see 'Praktische Insekten Kunde,' by Dr. E. L. Taschenberg, pt. iv., p. 151.

present in France, Germany, and Sweden, where it attacks both Oats and Barley. With us the attack has, as far as I am aware, been almost entirely confined to Oats and is caused by the maggot feeding in the heart of the young Corn-plant a little above ground-level, and eating away the centre, so that the shoot above the eaten part is destroyed, and the damage that is going forward then becomes noticeable from the injured shoots turning brown and withering, instead of continuing their growth.



Oscinis vastator: perfect fly, nat. size and magnified; and attacked plant, with maggot inside. (The *Oscinis vastator* of Curtis bears such a strong resemblance to the *Oscinis frit*—even if it is not absolutely the same—that I have used Curtis's figure to give the appearance of the insect and its method of injury).

The maggot is about the eighth of an inch long, whitish, legless, cylindrical, bluntly pointed at the head-end, which is furnished with a strong pair of curved mouth-hooks, and on each side near the head it has a branched spiracle. At the blunt hinder extremity it has two projecting wart-like spiracles.

The chrysalis is rather smaller than the maggot, cylindrical, and rather more pointed at the front than at the hinder extremity, which, from the strong projection of the two wart-like processes, has the appearance of being cleft, or almost bluntly forked, and for a time, after the maggot has changed to the chrysalis state, the branched external spiracles (or air-tubes) on each side of the head-extremity are very plainly observable.

In 1888, the only year in which we have record of this attack being prevalent to an observably serious extent in this country (when many enquiries and specimens were sent to me), I found that about June 27th the maggots were turning to chrysalids amongst the outer leafage of the destroyed shoots, and towards July 9th, Frit Flies were appearing from the

chrysalids. So far as was noticed the attack only affected Oat-plants, and notably, not Barley-plants. It was noted in one case as a peculiar fact that in "dredge-corn" (*i. e.*, Barley and Oats mixed), the maggot would attack the Oats and leave the Barley. In another instance mention was made of the damage being on Oats drilled about the middle of April, but that the other part of the field, being planted with Barley, did not appear to have been attacked.

Beside the attack to the young growing plant, great damage was recorded formerly in Sweden from the second or summer brood, the maggots of which fed on the soft grains in the ears of Barley, and thereby caused the light, worthless development of the Corn, known in Swedish as "frits," whence the name of the fly.

Up to 1888, in which the attack was very prevalent in Devon and Cornwall, I am not aware of Frit Fly having been present to a seriously injurious amount in Britain, although the presence of the *Oscinis vastator*, Curtis, which appears, as far as can be made out, to be the same as the *O. frit*, Linn., was watched, and recorded (in 1844) by John Curtis, in his 'Farm Insects.' In 1881 I was favoured, by Mr. R. H. Meade, of Bradford, with the information that the *Oscinis frit* had been observed in the autumn of that year in swarms in an out-building, in the lofts of which a lot of newly-threshed Barley had been stored, which points to the Swedish form of infestation being then present; but it was not until 1887 (the year preceding its remarkable prevalence) that I was able to watch this attack throughout its course up to development of the fly as a regular field attack.

Prevention and Remedy. — *Early sowing.* In 1889, Prof. W. McCracken, writing from the Royal Agricultural College, Cirencester, on August 1st, observed as follows:—

"The Frit Fly has again been the most plentiful of injurious insects, and, as was the case last year, the degree of injury corresponds to the date of sowing. For example, in one field Black Tartarian Oats (the sort most largely grown here) were sown on March 29th, and enjoyed almost complete immunity from attack; in another field sown on April 29th, over seventy per cent. of the first stems were destroyed. The plants which had their first shoots killed in this way immediately commenced tiller, so that the land continued to have a fairly close cover; but the secondary stems were always puny and unprolific, compared with the original ones.

"Early sowing, where possible, appears to me to be an obvious preventive, and a dressing of 1 cwt. or so of nitrate of soda to stimulate the crop to pass quickly through that

stage of its growth when it is liable to attack, is one of the best measures available."

From reports sent in, it appeared that after the maggots turned to chrysalis state, the infested plants (where they had not been destroyed past hope) threw out shoots, so that a crop was obtained, though from unevenness of ripening it was far from what could be wished. This suggests that if a stimulating dressing was applied when the damage is first beginning to show, time enough would thus be saved for a growth which would give a more even crop. The nature of the dressing will be best judged of by agriculturists themselves; but in a series of experiments on Oats (noted further on under the head of "Tulip-root"), it has been found now for some years that sulphate of potash, or a mixture of sulphate of potash with sulphate of ammonia and phosphates, answers exceedingly well in bringing on a healthy crop.

Where the crop cannot be saved, it is highly important so to treat the surface of the land that the maggots or chrysalids may be destroyed, which (if nothing is done, or the surface only lightly stirred or cultivated for another crop) will almost certainly produce a new brood of flies to continue infestation. For this purpose, ploughing with a skim-coulter attached, so as to bury the infested surface well down, would be about the best treatment.

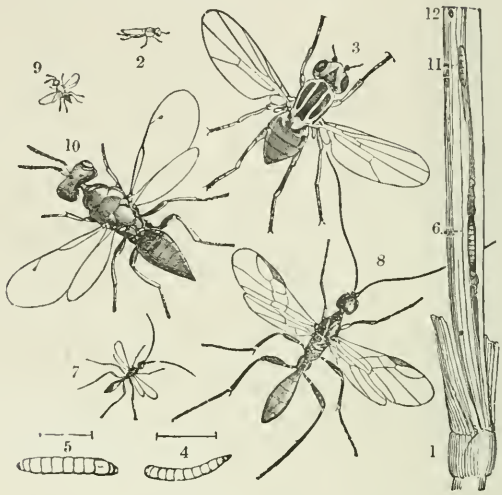
Looking at the point that in Sweden and Bohemia respectively, the maggots of the summer brood have been found feeding in ears of Barley and amongst the grains in Oat-heads, it appears so far possible that infestation may be imported in chrysalis form amongst the grain as to make it worth while to examine it, and if the little reddish-brown chrysalis-cases should be observed, to pickle the grain. For general appearance of the maggots and chrysalids of the Frit Fly as seen with the naked eye, those of the Wheat-bulb Fly (see figures under this head) may be taken as examples, and the method of injury to the young plant from the two attacks appears to be indistinguishable.

Gout Fly (Ribbon-footed Corn Fly).

Chlorops taeniopus, Meigen.

The attack commonly known as "Gout" is caused by the small black-and-yellow fly figured at p. 76. It affects Wheat, Rye, and Barley, but is most prevalent on Barley; and so long ago as 1841 it was recorded by John Curtis that Wheat in Surrey was infested; and Barley in Lancashire destroyed to a great extent by this attack. Now it commonly appears

yearly as one of our regular Barley pests, and sometimes (as in 1887) to a seriously injurious extent.



Chlorops tæniopus: 2—6, 11, maggot, chrysalis, and fly, nat. size and magnified; 7 and 8, *Cælinius niger;* 9 and 10, *Pteromalus micans* (parasite flies), nat. size and magnified; 1 and 12, furrowed Corn-stem.

The attack takes its common name of "Gout" from the swollen state of the heads when the ear is unable to burst the sheaths. Whilst the plant is still young, and the forming ear is wrapped in the sheathing leaves, the fly places her eggs either within these leaves, or so that the maggot can make its way through them to the ear; there it usually eats away some parts of the lower portion of the ear, and then gnaws, or rather tears, a channel down one side of the stem to the uppermost knot, and beneath the leaves the maggot changes to a reddish chrysalis, from which the Gout Fly appears about harvest-time.

The injured furrow down one side of the uppermost joint is the characteristic of the attack—joined to the enclosure of the ear in the sheathing leaves. This may be to any degree, from the plant itself being so stunted in early growth that the ear hardly forms, and the plant altogether looks like a thin side-shoot of Indian-corn, up to the ear freeing itself entirely, but still suffering from the stem being maggot-eaten (see figs. pp. 77 and 78). The maggot is yellowish-white and legless, tapering to the foremost end which contains the mouth-hooks, and blunt at the tail (see fig.), and the ochre-coloured or reddish chrysalis case may often be found in the blackened furrow caused by the gnawing of the maggot.

From this case the *Chlorops*, or Gout Fly, comes out towards the end of summer, as a small two-winged fly, about the eighth of an inch long, thick and stumpy in shape, yellow, with three black stripes along the back between the wings and the abdomen of a greenish black, with black cross-bands. The wings when at rest extend beyond the tip of the abdomen.

The winter attack, as observed in Germany, is from these flies laying their eggs on late-sown Corn or wild Grass. The maggot pierces into the neck of the plant and there winters, and in spring the diseased shoot forms a thickened growth with wide leaves, but the rest of the plant has not been found to be affected. The diseased shoot appears to die away gradually whilst the Gout Fly goes through its changes within, and comes out at the right time to start summer attack, as mentioned above.

From some slight observations or passing remarks this winter form of attack appears to exist in England, but I am not aware of it having been recorded in detail.

Prevention and Remedy.—When the plant shows the diseased forms of growth caused by the maggot it is too late to apply any remedy, and the best hope of prevention lies in date of sowing, or in such treatment of the land or position of the crop as will least expose it to attack of the fly, or may help it to push on so as to return some degree of yield even under infestation.

Early sowing with this as well as with the Frit Fly has been found of service. In observations reported to me by Prof. W. McCracken, from the Royal Agricultural College, Cirencester, of a Barley-field infested by this Gout Fly, he mentioned:—"The

Plant of Barley diseased by Gout Fly attack.

Stem of Barley showing blackened maggot-channel.

field was sown in three patches as the preceding crop of Swedes was fed off.

"The first patch was sown in March, and is practically free from injury.

"The second part was sown on April 6th, and is affected to the extent of about 2 per cent.

"The third part was sown on May 3rd, and has suffered to the extent of not less than 20 per cent.

"In 1887, Mr. J. G. Mann, of Bishop's Stortford reported to me:—'*Chlorops tæniopus* swarms in my *late* Barley, and also in my neighbour's. I also went into North Essex and South Cambs. last week, and found it there in all the *late* Barley.'"

Mr. Edm. Riley, of Hessle, near Hull, reporting on a badly infested field, mentioned, —"the attack was not 'Hessian Fly,' as it had begun *from the ear and worked down to the first joint.*" . . . "it had done *ten times* the amount of damage done by the 'Hessian Fly.' I and two other very practical farmers thought the crop was damaged *fully one-third.* The Barley (specimens sent) was sown *late;* the previous crop *Turnip,* and *very good;* one or two other late pieces of Barley are so infested."

I had also another note in 1887 (sent by Mr. J. Newman from Wilstead, near Bedford), mentioning that he found "a great many more" (of the infestations) "in late-sown Barley than in early-sown."*

When attack comes *on the plant not quite* in its early growth, the ear may be so far advanced, or the plant so strong that it will push on, and very likely three quarters of the ear may be saved, as shown in figure; but where the attack comes on it whilst very young, as with late-sown Barley, or from any cause in state of land or state of weather, the plant is stunted down, as was the case very generally in 1889 (see fig., p. 77), the loss is total.

Attack has been recorded (and I have observed it myself) as especially bad on wet, low-lying parts of fields, or along the water-

* See 'Report of Injurious Insects,' observations (by Ed.) for 1888, pp. 55 and 58.

furrows, *or near Grass headlands** where the ground was sheltered and damp; also where the land was exposed to a sweeping wind.

Looking at the very various situations and circumstances in which "Gout" is notably to be found, I should conjecture that the fact is that the fly comes out of the wild Grasses along the headlands, and is specially attracted by the plants in the moist situations, and as summer advances the sodden ill-drained parts bake hard, and the plant cannot make way under the infestation. Where attack recurs (as it sometimes does) in any special locality, the state of drainage and condition of the soil should be seen to. The maggot itself cannot be acted upon by dressings whilst wrapped in the growing shoot, but as the injury consists in the distorted and retarded growth of the attacked ear or Corn-stem, it is probable that artificial dressings applied in the early stage of the summer attack would do much good.

One hundredweight and a half of guano mixed with two hundredweight of superphosphate, applied at the time of sowing, when fears are entertained of attack, or one hundredweight nitrate of soda mixed with two hundredweight of common salt applied when the braird has come well up, or when the crop is attacked, would be likely to prove beneficial. Salt would check any tendency of the plant to run too much to leafage, as a consequence of the action of the nitrate. The application of salt at the rate of from three to four hundredweight per acre has been recommended.

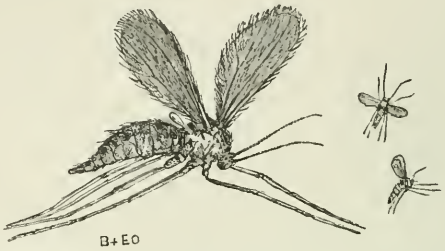
Drawing out and destroying the badly-injured plants, which are especially to be observed along the water-furrows and edges of crop near Grass headlands, is desirable in theory as a means of prevention of future attack, but very unlikely to be carried out in practice; and likewise, where the little stumpy-made black-and-yellow flies are found in the great numbers in which they sometimes are observable at threshing-time, they should be swept together and destroyed.

The Hessian Fly. *Cecidomyia destructor*, Say.

The year 1886 was memorable, agriculturally, for the appearance of the Hessian Fly as a pest of the Wheat and Barley in Great Britain. Whether the fly had been present before 1886 we cannot tell, but we can tell very certainly that it was not *known* to have been present; and also that its

* See observations beginning "The winter attack," p. 77. It appears very likely that the summer attack, *with us*, comes from infested wild Grasses.—Ed.

attacks had not been recorded agriculturally; nor had the fly, the *Cecidomyia destructor*, Say, been entered in the lists of British insects.



Cecidomyia destructor (Hessian Fly): nat. size and magnified.

On July 27th the first specimens of the flax-seed-like puparia or chrysalis-cases were forwarded to me by Mr. G. E. Palmer, from his Barley-fields at Revell's Hall, near Hertford, and I went as soon as possible to examine the nature of the infestation in the field. The peculiar form of the puparia, and also the peculiar nature of the injury to the infested Barley-straw, showed clearly the nature of the attack; and on the 8th of September the first imago developed from my specimens, and proved to be the true *Cecidomyia destructor*, Say, commonly known as the "Hessian Fly."

The presence of an infestation which in other countries was known to have caused in some instances the most serious results, was a fact which it was necessary to make public at once, and which attracted enormous attention.

In 1886 the Hessian Fly attack was reported to me, with specimens accompanying, from localities near Hertford, Ware, and Romford, in England, and from near Inverness and near Crieff, in Scotland. These infestations were almost entirely to Barley, though in one case to Wheat.

In 1887 the area of its presence increased to a more or less broad band, sweeping with occasional intervals up the eastern side of the kingdom, from Kent, in England, to Cromarty, in the north of Scotland; and was also present at some localities in the south of England. Both Wheat and Barley were attacked, but the infestation could not be heard of (on special enquiry being made) as having reached so far north on the mainland of Scotland as Caithness, nor as being to be found in the Orkney Islands. Altogether, the localities of infestation which I could speak to with certainty in 1887, —from reports sent to myself by contributors conversant with the subject,—or with specimens accompanying, amounted

to upwards of 72 in England and about 20 in Scotland, these being centres often representing districts and sometimes many miles of area of attack.

In 1888 there was a most marked and satisfactory decrease of presence. Little mention of the presence of the pest was made in the agricultural journals save a note somewhat vaguely worded of it being "all over" one of the southern counties, and only about six reports were sent to myself, although I had reason to believe infestation was reliably reported in a few other cases.

In 1889, again, there were only about the same number of reports sent; but in almost all these instances, where it was observed at all, it was noted as being very prevalent, that is, it was noticeable on much of the straw; but also it appeared, from my own observations and report sent, that each attacked straw often was not infested by more than one or two maggots.

In the same year it could not be found at Daleally Farm, near Errol, the locality of one of the first observations of Hessian Fly in Scotland, and no reports of its presence were sent me from Scotland; nor has it yet been recorded as found in Ireland.*

At present we are only aware of the summer form of Hessian Fly attack (that is the attack to the growing straw) being observed in this country.

The minute reddish eggs are laid so that the maggot which hatches from them can place itself a little above a knot, and there, remaining quietly at one spot, the white legless maggot † (or in bad attacks many of the maggots) feed by sucking away the juices outside the stalk, but inside the leaf-sheath. Commonly this is just above the second knot, but the attack may occur lower down at the first knot, or close

* In the above notes I have specified the information as being reported to myself, as the most vague and wild ideas were prevalent, and it was impossible to report anything on the subject trustworthily without examination of specimens, or from qualified observers.

† "*The egg* is very minute, about the fiftieth of an inch long, cylindrical, pointed at each end, the shell shining and transparent, the egg being of a pale red colour when the embryo is nearly developed."

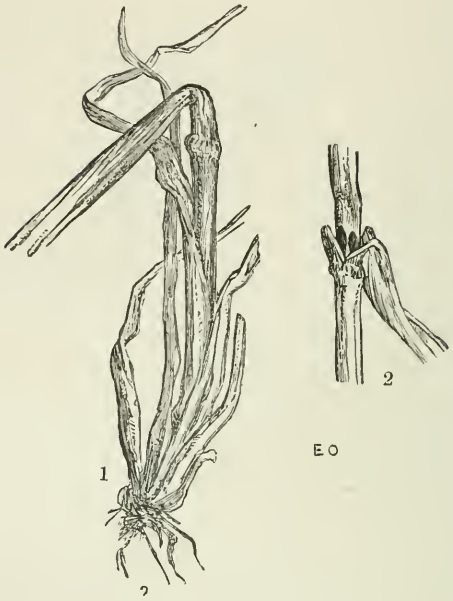
"*The larva.*—After remaining about four days in the egg-state the larva or maggot of the Hessian Fly hatches, and is of the form represented. The body is soft, smooth, shining, oval, cylindrical, beneath a little flattened, and consists of twelve segments besides the head, the latter soft, fleshy, and but little separated from the body, with very rudimentary mouth-parts."—'Hessian Fly Report of Department of Agriculture,' U.S.A., 1880–82, p. 208, previously cited.

The figures of egg and larva are copied from the same report.

R+P

Egg and maggot of Hessian Fly, nat. size and mag.

to the root; or it may occur higher up above the third or fourth knot.

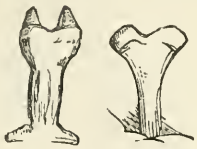


Attacked Barley-stem: 1, bent down; 2, showing "flax-seeds."

The mark of attack being present is the stem elbowing sharply down just above where the maggot lies. It does not commonly break, but, unless the straw is very firm, it bends at the infested spot, and thus damage is caused to the fallen head, besides difficulty in reaping from the confused state of the straw. The injury is caused by the fly-maggots lying at the same spot sucking the juices from the stem, which is thus weakened, and presently, although both the stem and the ear above are (in any important amount of attack) more or less stunted, yet the weakened piece of stem cannot bear their weight, and it bends sharply down at the injured part. Sometimes a gall or swelling of the stem occurs just above where the maggot fed, but in the specimens I examined this was rarely noticeable.

The whitish maggots will often be found to have a green tinge running along them,—this is caused by the green plant-juices showing through the transparent skin. Beneath the maggot at the head-end is a horny or chitinous appendage (see figure) which is found on cecidomyideous larvæ and is known in America as the "breast-bone, with us as the "anchor-process." The presence of this peculiar appendage

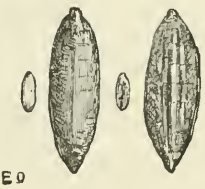
is a very convenient way of knowing this kind of larva from those of the common fly maggots (dipterous larvæ) which infest Corn. The process consists of a short stem fixed at one end to the larva and free at the other, which is enlarged and of very variable form.



1, Anchor-process of larva of *C. destructor*; 2, of *C. tritici* (magnified).

The use of this appendage does not appear as yet to be fully known, but from my own observations I conjecture that it is used as a digger or scraper to assist the excessively delicate mouth-parts in acquiring their food from the stem.

It appears from Dr. Lindeman's careful observations in Russia that the larva (or maggot) lives about twenty-eight days in this condition. Then it changes at the precise spot at which it fed to a brown flat chrysalis, in size and shape and colour strongly resembling a rather small and narrow flax-seed, whence the name of "flax-seeds" is commonly given to these chrysalis-cases or puparia. At first, as will be seen by the figures, these puparia are smooth on the surface, but gradually become wrinkled longitudinally. Within this hard outer husk the maggot changes to chrysalis, and the chrysalis to the perfect fly, but how long this may take depends very much on circumstances. It may occur, under natural and favourable circumstances, so soon that the whole time occupied in the life of the fly from egg to development is only about forty-eight days; but it has been shown that if the *puparium*—to give it the precise name—is put in unfavourable circumstances, development may be greatly retarded. Thus, some of the flies may come out in autumn in the fields, and others threshed out, or stacked in the straw, or kept artificially for investigation, may very likely not hatch until May, or much later in the following year.



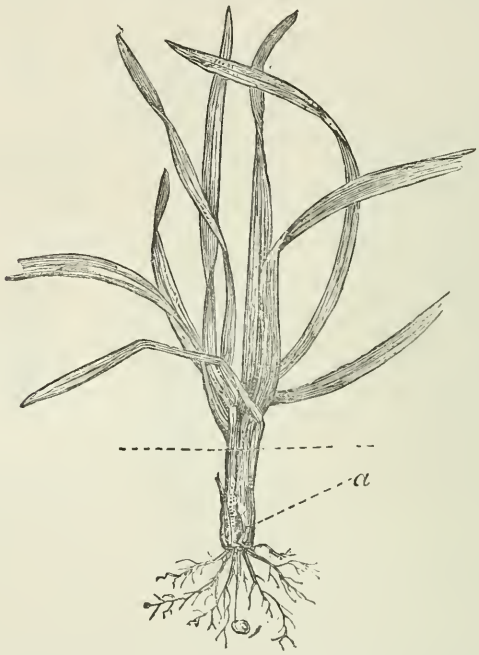
"Flax-seeds" or puparia in different stages of development, nat. size and magnified.

The perfect fly much resembles a stout-made little brown gnat, about one-eighth of an inch in length, with one pair of smoky-grey wings, and with long horns. (See fig., p. 80).*

At present we have no reason to suppose that we suffer in this country from Hessian Fly attack to the young autumn-sown Wheat-plant. In this form of attack the maggot (from

* A full scientific description of the male and female fly, taken from living specimens, by Mr. R. H. Meade, of Bradford, will be found in the number of the 'Entomologist' for July, 1887, and also in my 'Report on Injurious Insects' for that year. Published in both cases by Simpkin & Co. London.

the eggs of the flies of the autumn brood) is stated to "lie at the sheathing-base of the leaves of the young plant just above the roots, at or near the surface"; and "before assuming the 'flax-seed' state, rests between the leaves and the stalk."*



Plant of young Wheat, showing position of Hessian Fly maggot at "*a*" (after Prof. Webster).

"The plant itself has not tillered, the leaves are of a *darker* colour than those of a healthy plant, and proportionally broader. The central spindle-shaped leaf is missing, and the whole plant is only a bunch of rank-growing leaves. In any case the darker colour of the leaf, and the absence of the central leaf, together with the bunchy appearance of the part affected, will readily distinguish a fly-infected plant from one not injured. The yellow colour of some leaves is seldom observed, at this season of the year, on fly-infested plants." —From circular by Prof. F. M. Webster, of Lafayette, Ind., U. S. A., on Hessian Fly maggot-attack to young Wheat.

Prevention and Remedies.—*Late sowing of autumn Wheat.* This is a point which great stress is laid on in American

* See Bulletin 4 of U.S.A. Entomological Commission.

practice, and it is especially recommended in the United States (where autumn Wheat-sowing runs earlier than with us) that Wheat should not be sown until after the 20th of September in the Northern States.

In this country this remedy is applied for the most part in regular process of farming arrangements; commonly our Wheat is not sown until some time after date named, and thus the young plant is not up until the flies which would have laid eggs on it are dead.

It is quite a plain thing that if, when the flies come out from the chrysalids, there is nothing suitable for them to lay their eggs on,—that either the eggs will not be laid or the maggots from them will be starved to death.

Thus so far we have escaped the winter attack to the young plant which is a most important matter, and in fact at once saves half (and what I am informed by Prof. Riley, Entomologist of the Department of Agriculture, U.S.A., is considered the most important half) of the year's mischief caused by this pest.

Destruction of "flax-seeds" found (after threshing infested straw) in siftings or light grain is one method of quite certainly lessening amount of coming attack.

In the special report on this subject sent me in 1886, by Mr. D. Taylor, Jun., of Daleally Farm, Errol, N. B., he mentioned that he not only found the "flax-seeds" in the "siftings," but that they were still more noticeable in the light grain or "shag" which fell immediately behind the dressing-fanners, or is delivered at the side by a "shag" or "tail-spout," also amongst the earth and small weed-seeds which fall through the sieve below the fanners."

The proportion of "flax-seed" to the handful was found to be much larger in this light corn or "shag" than in the siftings. In these the amount of "flax-seed" ran to about twelve to fifteen to the handful, but in the light Corn as many as nearly forty to the handful were found.

It is a great point in prevention to destroy these infested screenings. Where they are merely of dust, rubbish, and weed-seeds, it would be little trouble or loss beyond cost of labour to have them burnt, or by any other more convenient way thoroughly destroyed; and where they are in the light grain, this should be treated so as to prevent the "flax-seeds" being distributed with it. Mr. Taylor wrote regarding this point:—"We are boiling those 'flax-seeds' which are amongst the shag along with it, and feeding our horses and cows with it; the weeds and dirt are promptly destroyed." But in whatever way each owner may think fit to manage it, the matter of destruction of these "flax-seeds" is highly im-

portant, or in due season the insect-pest will be likely to hatch out and start new attack. Whether these chrysalids or "flax-seeds" have their vitality destroyed by being swallowed along with the light-grain food of the stock does not appear, but, judging by what happens in other cases, it is at least so far possible as to make the thorough scalding of them very desirable, as well as to kill those which might develop their flies (otherwise) at once.

Prevention by ploughing in, or by burning infested stubble.—With regard to such amount of "flax-seeds" as may be left on the land, either on infested stubble or fallen therefrom to the ground, there does not appear to be any way of getting rid of these excepting by such ploughing as will bury them thoroughly down, or by burning the stubble.

The kind of plough needed is one fitted with a "skim-coulter," or skim-share, which can be fastened to the beam and removed at will. This chips the surface, so that it can be turned down with the furrow, and would answer well if care was taken that the "skimmed" piece was *thoroughly buried down*. If this is done, the weak little Hessian Flies cannot by any possibility (even if they developed down below) struggle up through the *overlying* load of earth. But it must be thoroughly done.

If only common ploughing is done, and the edges of the land-slice left running in ribbons of stubble and weeds exposed to air and light, on the back of the previous one, then what "flax-seeds" may be there will be little injured, and will be likely to give out their pests in due season.

When once turned down the infested land should *not* be turned up again, until the season for the appearance of the next brood of Hessian Flies has passed, and therefore only crops requiring surface cultivation should be taken from the land.

Burning infested stubbles.—Where nothing further can be done, it is at least desirable, directly after harvest, to skim infested stubbles and drag the rubbish and burn it. Thus all of the pest that may be left will be destroyed; and experience has shown that the "flax-seeds" may be found *at the ground-level*, and at the first knot, as well as at the second knot, and higher yet.

Where complete firing of the infested stubble can be safely done (and I have myself seen in many cases that this could be carried out) the plan is very desirable.

But in burning stubble it is not right to let the fire go wildly as the wind may drive. The right way is to fire the field at the borders first. Thus there is only a slight warmth at first, and a line of fire quite under control near the hedges.

The fire as it spreads draws towards the middle of the field, and, however the wind may drive, the flames cannot return over the already charred surface.*

Treatment of infested straw after threshing. — In regard to infested straw taken off the field, it has been found to answer well to stack this carefully after threshing, well built up square and firm, like a haystack, instead of throwing it anyhow; thus a very great proportion of the flies which come out of the "flax-seeds" are destroyed, simply because they are not able to get to the outside of the stack.

The kinds of Corn attacked are Wheat, Barley, and Rye. Oats are not known to be attacked, neither are any of the crops known as roots, such as Turnips, Mangolds, Potatoes, &c.; nor Pulse, as Peas, Beans, &c.; nor Cabbage, Flax, Mustard, or ground or bush fruit-trees. Rotation of crop with most of these would both ensure safety from the pest to the crop itself, and also, by removing the food necessary to the insect, would give a thorough check to its presence so far as that crop was concerned.

Two kinds of wild Grasses subject to attack of Hessian Fly are "Timothy Grass" (*Phleum pratense*) and "Couch Grass" (*Triticum repens*).

In 1887 the first-named of these was found to be severely attacked in the Russian Government of Tambov, and Couch Grass was attacked in the government of Tambov, and also of Woronetz; "Couch Grass was so severely attacked that in whole districts covered with this Grass it was destroyed."

There has been doubt and difference of opinion as to other kinds of wild Grasses which may be liable to infestation, but the above observations give an additional reason for skimming and dragging rubbish together and burning it in the fields, and also for preventing neglected Grass or hedge-banks by Corn-land being allowed to become nurseries of the Hessian Fly.

A firm, stiff-strawed kind of Wheat or Barley, and such cultivation of the land and choice of soil, and also exposure, as will give a vigorous and healthy growth, are the best means of reducing amount of damage to be expected if attack comes.

The stiff straw does not elbow down readily under moderate infestation, and where there is healthy growth the plants will stand an amount of loss of sap from maggot-suction which would have ruined them if weaker. A crop of Barley grown on a dry hot exposure may be seen going down under

* For the above hints I am indebted to Prof. Hoyes Panton, of the Agricultural College, Guelph, Canada.

attack, whilst one a field or two off, in a more suitable position, is as well as could be wished.

Parasites.—It is not necessary here to enter in detail on the subject of parasites infesting the Hessian Fly, as it is impossible for any one without good knowledge of the subject aided by type specimens, descriptions, and fairly good (or rather powerful) magnifiers to identify them trustworthily. Those who wish to study them will find descriptions in 'Die Pteromalinen der Hessenfliege von Prof. K. Lindeman,' Moscow, 1887, and in the publications of Prof. C. V. Riley (Entomologist of U.S.A. Department of Agriculture) "On the Parasites of the Hessian Fly."

Our own parasites of this *Cecidomyia destructor* were determined first by means of specimens bred in this country, which I forwarded to Dr. Lindeman (above mentioned), who identified them, and who was good enough to send a set of specimens of Russian parasites to Prof. Riley and one to myself.

The subject was gone into with the most extreme care by Prof. Riley, during his stay in England in 1887; and I have in my possession the long detailed communication he was good enough to give me, containing his most valuable observations as to identity, synonyms, slight or important variations in our British parasites considered with reference to published descriptions, to which he appended the remark:— "Thus every one of Lindeman's forms have been reared in England. I should not have been able to speak so positively without his types, which he has been kind enough to send me," . . .—(C. V. R.)

In the pamphlet by Dr. Lindeman, 'On the *Pteromali* of the Hessian Fly' (pp. 14 and 15), above alluded to, he gives the following observation as the result of his examinations:— "That the larvæ of the *Cecidomyia destructor* in North America and in Russia are certainly infested by *Pteromali* of the same genus, but do not produce any identical species, as is shown by the following comparative lists:—

Larvæ are infested in N. America by—	Larvæ are infested in Russia by—
1. *Merisus destructor*, S.	1. *Merisus intermedius*, Lindmn.
2. *M. subapterus*, Ril.	2. *Tetrastichus rileyi*, Lindmn.
3. *Tetrastichus productus*, Ril.	3. *Eupelmus karschii*, Lindmn.
4. *Eupelmus allynii*, Fr.	4. *Platygaster minutus*, Lindmn.
5. *Platygaster herrickii*, Pask.	5. *Semiotellus nigripes*, Lindmn.
	6. *Euryscapus saltatus*, Lindmn.
	7. *Platygaster?* sp."

Dr. Lindeman's list of the Russian parasites is that of which I have the advantage of possessing Prof. Riley's commentary.

The examination of our parasites pointed therefore very strongly to the probability of our Hessian Fly attack having been imported to us from the East of Europe.

? Attack imported in foul Corn and spread in infested screenings. — Long and careful investigation of imported straw, at ports on the East of England, gave no reason at all to suppose that it came in straw imports; but nothing is more likely than that infestation should come by means of so-called "flax-seeds" in foul grain imports; and the practice of purchasing the screenings of these cargoes, foul with injurious insects, weed-seed, ergot, and any other adulteration that may chance, is a most fertile cause of infestation, both of field and granary, whether Hessian Fly "flax-seeds" be in it or not. *

Wheat Midge (Red Maggot). *Cecidomyia tritici*, Kirby.

The grub of the Wheat Midge, known as the "Red Maggot," often does some harm, and at times causes a serious amount of damage to Wheat-crops, by injuring the young grains when forming in the ear, so that many of them never reach maturity.

In June, when the Wheat is in blossom, the female Midges may be seen laying their eggs, and are noted as being busiest at the work about 8 o'clock in the evening. In the morning

* Information regarding the Hessian Fly, its habits and history, and means of prevention and remedy, will be found in especial detail in the following works:—

'The Hessian Fly; its ravages, &c. U.S.A. Department of Agriculture: Third Report of Entomological Commission. Washington, 1883. (Reprinted, with additions and corrections, from Bulletin IV. of the U.S. Entomological Commission. By A. S. Packard, jun., 1880).'

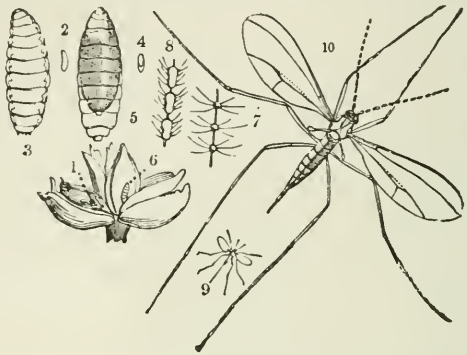
'Untersuchungen über die neue getreide gall-mucke. Von Dr. Balthasar Wagner. Fulda & Hersfeld. 1861.' (English translation will be found in Appendix to 3rd Report of Entomological U.S.A. Commission mentioned above, pp. 8—38).

'Die Hessenfliege (*Cecidomyia destructor*, Say), in Russland von Dr. K. Lindeman. Moscow, 1887.'

In my own pamphlets, 'The Hessian Fly in Great Britain' (1886), and 'The Hessian Fly in Great Britain in 1887,' and in my Reports on Injurious Insects (Messrs Simpkin & Co.) I have recorded its first appearance in this country, with descriptions and identifications, and notes of habits, &c.

Also, as on the appearance of this fly, the *Cecidomyia destructor*, in Great Britain, the observations of the attack, with enquiries and specimens, were forwarded to myself and identified first by myself, I have carefully preserved in one large volume the communications received announcing its first appearance, the confirmation of my identifications by Prof. J. O. Westwood (Life President of our British Entomological Society) and by the Canadian official Entomologist, and other observations as to habits, amount of injury, &c., which are valuable as first observations of an attack, previously not only unrecorded as present here, but also specially watched for and recorded at intervals as not being found in this country. (E. A. O.).

they may be found resting on the lower part of the culm of Wheat, with their heads downward, flying about, however, in great numbers near the ground when the stems are shaken.



Cecidomyia tritici: 1, 6, infested floret; 2, 3, larvæ; 4, 5, cased larvæ or pupæ, nat. size and magnified; 7 and 8, part of horns, magnified; 9, 10, Wheat Midge, nat. size and mag.

The females (see fig.) are furnished with a long ovipositor, as thin as a hair, which they can extend at pleasure, and thus insert their eggs inside the florets. The eggs are oblong and transparent, and (with the help of a glass) may be found in little patches of from one up to twenty in number.

The maggots have been found ten days after the deposit of eggs was observed, some with their heads in the woolly top of the germ of the future grain, some inside the sheaths of the flower.

The following notes from personal observation, sent me in 1883, by Mr. Russell Swanwick, from the Royal Agricultural College Farm, Cirencester, are valuable in showing the time of day of appearance of the "Midge," and also the great amount of infestation which may take place from neighbouring land:—

"The day before yesterday (July 1st), I examined some heads, and found a good many very small Wheat Midge grubs crawling about, chiefly inside *the outside chaff*, but very few actually attacking the grain, which was just beginning to form. There were a large number of Wheat Midges flying all about amongst the Wheat-stalks, but being rather early in the evening they had not mounted to the heads.

"I then searched the hedge-sides, amongst the grass, and found it as full of them as the Wheat. Wishing to know whether this was their hatching-place, or whether they came from an adjoining field, which is now Clover, but which had been Wheat the previous year, I went into this field, and at once observed a cloud of Midges rise when disturbed, which

on closer inspection proved to be Wheat Midges. I should estimate them as ten times as numerous as in the Wheat.

"I have been in the habit of sowing my Grass-seed with the Wheat crop, so as to keep my Barley free of Grass, and hence obtain a better quality; it is possible that this custom may have rendered me more liable to the Wheat Midge attack than if the Wheat had been sown without seeds, and the stubble had been ploughed in."

These maggots are lemon or orange-colour, more pointed at the head than the tail, and legless, but wrinkled transversely into folds, by means of which they can wriggle themselves along at pleasure and are very small, only about the twelfth of an inch long.

When full-grown, some of the maggots go down into the ground, but such as have not left the ears when the corn is cut are harvested with it. This is important as regards treatment, but does not show any variation in the habits of the grub, as, if the corn had been left alone, it would have fallen, and the grubs thus come to the ground in the natural course of things. After a time they may be found in filmy transparent cases (see figs. 4, 5, p. 90), and turn to reddish pupæ, lighter at the end of the tail, from which the Midges appear in June.

The "Midge" is orange-yellow, or ochreous, with black eyes, and (as observable in the magnified figure) the longest vein of the wings is not forked.

The following observations, on a kind of Cecidomyia *which infests Meadow Foxtail Grass, are added because as yet it does not appear certain whether this is the* C. tritici *or another species; consequently its presence may influence infestation in Wheat*:—

Early in the year 1884 I received specimens of larvæ from Mr. James Hunter, of Chester, taken from seed-heads of *Alopecurus pratensis*, which proved to be maggots of a *Cecidomyia*, and very nearly, but not quite, similar to the well-known Red Maggot of the common Wheat Midge, *Cecidomyia tritici*; and from further examination during the season it appeared that the Foxtail Grass was subject to attacks of one or more kinds of these Wheat or Grass Midge maggots. They were found by Mr. Hunter badly infesting Meadow Foxtail heads in the neighbourhood of Chester; and Mr. Edw. Baillie (also of Chester), in details of observations with which he favoured me, mentioned that on June 10th they were noticeable in great numbers in *the evening*, and again on June 26th, although at 5 a.m. he only secured two, yet in the evening they were plentiful. "I watched their habits closely for a time. I find they *rise from the lower leaves, fly about until they rest either upon the head or upon the stalk of an*

inviting grass; invariably, so far as I see Alopecurus. One alighted upon the stalk, ran rapidly up it until it reached the head, and there remained contentedly."—(E. B.)

These maggots were orange-red, of various depths of colour, and they varied also in form of the anchor process, and also in this process being sometimes either not present or not observable. The Midges which were reared by Mr. Baillie were examined for me by Mr. R. H. Meade, of Bradford, who stated the insect belonged to the *Cecidomyia*, subgenus *Diplosis*, H. L. W., and he considered it was probably a new or undescribed species. The specimens sent might possibly be small varieties of *C. tritici*, but as all that were sent were females the kind could not be determined with certainty. *

1 and 3, Anchor process of Foxtail Grass maggot; 2, of Wheat Midge maggot.

Prevention and Remedies.—The best method for prevention of this "Red Maggot" is to give it no winter shelter, which is *naturally* at the roots of the Corn crops or of Couch (and possibly some other) grasses; *artificially* in large chaff-heaps. The chaff-heaps and the rubbish and dust from the threshing-machine can be easily managed; and in the fields a great deal of the Red Maggot may be got rid of by special methods of ploughing, or by taking the cultivator through the land, and collecting and burning the stubble-roots.

In Canada, when this maggot was especially hurtful, it was considered a complete cure to turn down the surface of the field with the Michigan plough, which, with the first turn-furrow, takes off about two inches of the surface, together with the weeds and stubble, and the insect-vermin in the roots, and deposits them at the bottom of the furrow; whilst the second turn-furrow raises another land-slice, and, depositing it over the previous one, buries it several inches deep. If the course of agriculture allowed this to be left untouched till after the usual time of appearance of the Wheat Midge in the following year, it was found to completely destroy the maggot.

In our own case, such ploughing and working of the surface might be effected by having a skim-coulter attached to the plough (see also p. 86), constructed in such a manner as would cut and lay an inch or two of the surface in the bottom of the preceding furrow, thereby burying the Red Maggots to such a depth as would render their coming to the surface (or being brought to it by after cultivation) very improbable; or

* 'Eighth Report of Observations of Injurious Insects,' by E. A. Ormerod.

broad-sharing might be adopted, which would tend to break up the surface soil.

If the weeds, stubble, and grass-roots were collected and burnt, this would help to destroy many of the maggots,* and a large proportion of the remainder would be left on the top in reach of birds. The above operations would be of service by putting the maggot in unnatural circumstances, from which a large number of experiments have shown it to be particularly susceptible of injury.

Another point of great importance is in regard to the grubs harvested in the Corn. Enormous quantities of these may be found in the chaff or the dust after threshing; and on neglected farms or small holdings where the chaff is often thrown in heaps to decay in out-of-the-way corners, this treatment suits the Wheat Midges most admirably. The following June brings them out in clouds from the heaps to infest every Wheat-field near, and this practice, therefore, of spreading them is most objectionable.

It is also bad in another way by greatly increasing the opportunities of multiplication of the Midge.

As it has been noted by careful observation that the Wheat Midges seen in the Wheat-fields were all females, it may be supposed that few, if any, males were there; and from my own observations of the Midges over the chaff-heaps, I am led to think that pairing takes place immediately on the hatching of these Midges from the pupæ, and thus these vast collections are doubly hurtful. The heaps preserve the grubs through the winter, and from the quantity (probably) of both sexes that are hatched in one locality, the female flies to the fields in a condition at once to lay fertile eggs.

Where chaff is thrown away, it would be no greater loss to destroy it thoroughly by burning with other rubbish, or, if used as litter, it could be placed in the bottom of the yard, where the trampling amongst the wet droppings of the cattle would kill the maggots. Or again, the chaff might be placed in the bottom of the dung-pit, where the maggots would be effectually destroyed, and in this way there would be an increase of good farm-manure, with a saving of much more mischief from "Red Maggot" next season than is generally supposed.

From experiments tried there seems some reason to think that sowing the seed of Foxtail Grass with the maggot amongst it is followed by attack, and from the winter state of some of the maggots which I have seen this seems likely

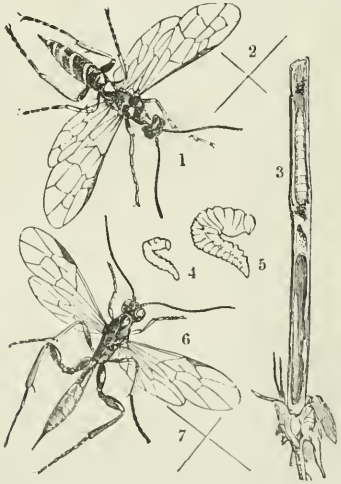
* Firing the stubbles, in the manner mentioned at p. 86 under the head of "Hessian Fly," would help to get rid of many of the Red Maggots which may be found clinging about the lowest part of the stalk after the harvest has been cut.

enough. If this should be the case with Wheat seed from infested ears it might be remedied by "pickling."

In the American and Canadian experiments, it has been found of great service so to time the Wheat-sowing that the period of flowering should be clear of that of the appearance of the Wheat Midge. In the uncertain climate of our country any experiments depending on weather are of doubtful use, still the point is worth consideration. We have observations, made in the wet summer of 1879, which show instances of escape of the later ripening Wheats from attack, because time of oviposition of the Midges was gone by before the ears were ready to receive the eggs.

It is observed by Dr. E. L. Taschenberg* that if when the Midge appears there are no Wheat-ears ready for it, that the Midge will seek the Rye-ear—should both these or the Wheat-ears, which it prefers, fail it, then it will choose the heads of the Couch Grass for deposit of its eggs. Therefore it is desirable to destroy Couch Grass in the neighbourhood of Corn-land, or even rough mowing, or "skirming" before flowering time, would also do much good; and the Meadow Foxtail Grass is certainly at present open to suspicion of infestation.

Corn Sawfly. *Cephus pygmæus*, Linn.



Cephus pygmæus, Linn.: 1, 2, Sawfly, magnified, with nat. size; 3, stem containing maggot; 4, 5, maggot, mag. and nat. size; 6, 7, parasite fly, *Pachymerus calcitrator*, mag., with nat. size.

* 'Praktische Insekten Kunde,' pt. iv., p. 16,

The first sign of coming Sawfly attack consists in the flies being observable on the stems or heads of various kinds of Corn or Grass early in the summer. On the 28th of June in 1887, the year of the most serious attack of this insect of which I have record, Mr. T. P. Brand, of Brook Hall, near Long Melford, forwarded me specimens, with the information that he had caught them off his Wheat on the previous evening and seen many more.

The method of attack is for the female by means of her ovipositor to pierce the Corn-stem, just below or at one of the knots, and there insert one egg, continuing this process successively to other straws, till her egg supply is exhausted.

The maggot, which hatches in about ten days, is of the shape figured opposite at 4 and 5, about half an inch long, yellowish white, fleshy, with a horny rusty coloured head, and is peculiar in being footless, although the larva of a Sawfly. At the extremity of the tail is a tube-like appendage or extensile tip, which helps the maggot in its progress along the inside of the straw. It feeds on the soft inner substance, clearing its way sometimes through the knots, sometimes even through the topmost, and when nearly full-grown comes down inside the stalk on which it has fed; and about harvest time, or a little before, it comes down to ground level, where it gnaws a ring so neatly and cleanly round inside the stem, that the straw readily falls with its own weight, or from slight pressure of the wind, the severed stalk showing almost as smooth a fracture as if it had been separated by a knife. When the maggot has thus travelled down the stalk and nearly cut it through (so that nothing may prevent its escape presently as a fly), it goes down into the lowest part and spins itself a silken case, in which it passes the winter. It changes to a pupa in the early summer of the following year, and comes out as a fly, just in time to attack the new crops.

The fly (see fig.) is four-winged, black, and more or less marked or spotted with yellow on the head, abdomen, and legs. The yellow is bright in the male; more of a sulphur or ochre-colour in the female; and the wings are iridescent in the male; more smoky in the female.

These infested stalks may be known, in the growing crop, partly by the thin white ears standing upright and empty, or with few perfect grains;* whilst the healthy plants are still green, and in some degree bending with the weight of the head; partly also by the stalk in some cases containing saw-dust-like excrementitious matter consequent on the Sawfly

* There is another Wheat attack (known as "White-ears") somewhat resembling that of Sawfly in the appearance of premature ripening. For description of this see note appended to paper on "Thrips."

maggot feeding within, which lowers the value of the straw for plaiting purposes. Later on, where attack is severe and crop at maturity, the field will appear as if storm-broken, from the irregular falling of the severed straws.

Prevention and Remedies.—The maggot cuts the Corn-stalk below where the cutters of the reaper separate the stems, and it remains, not in the upper part, which is carried away, but down in the stump which remains in the ground. It winters inside the lowest part of the stalks of the stubble; therefore any means whereby the stubble may be destroyed, or buried too deeply for the fly to come up again after it has developed, will be serviceable.

Where there has been a bad attack, it is desirable to collect the rubbish, that is, the roots of stubble, and either burn it in heaps on the field, spreading the ashes afterwards over the surface, or cart it off the land with the weeds, which, mixed with quick-lime or gas-lime, forms a foundation for a good compost-heap, and either treatment is a sure method of destruction of the grubs.

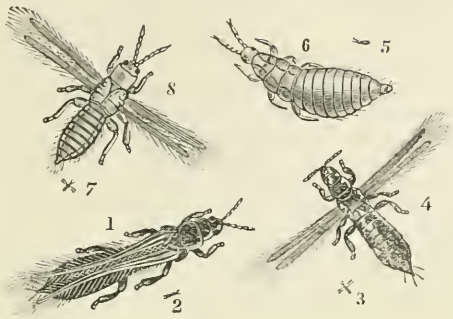
The clearing of the ground might be effected either by a Biddle's scarifier or the broad-share paring-plough; or a common plough, with its mould-board unattached, and fitted with a share a foot in breadth, might be set to work on the stubble after the grain-crop is carted, and skim off the surface to the depth of three or four inches; the harrows will shake the earth from the roots, and a turn of the chain-harrows collect the refuse, which may be disposed of as above mentioned.

Ploughing would not be a sure preventive unless the stubble was thoroughly well buried down; if only partly buried the maggots would probably be no way injured. If it could be completely buried down and left there this would answer; but I believe the most sure plan is after harrowing, &c., to collect the stubble in heaps and burn it.

Burning the standing stubbles has been recommended, and is an excellent method of destroying the maggot; in some cases, by the elevation of the finger bar of the reaper, the stubble may be cut at such a height that the simple act of setting the residue on fire will burn the whole surface of the field, and prove a thorough remedy. (For the best method of firing a stubble see p. 86).

The Sawfly does much harm on the Continent, and is common in this country, in Corn-fields and on grasses growing in the woods in June; but is rarely known as one of our bad crop-pests.

Corn Thrips. *Thrips cerealium*, Haliday; *T. physapus*, Kirby.



1—4, Corn Thrips, *Thrips cerealium* (female), nat. size and magnified;
5—8, Potato Thrips, *T. minutissima*, nat. size and magnified.

The attack of Corn Thrips is one of those which often does a great deal of harm very quietly, and without the cause of the mischief being suspected, on account of the minute size of the insect, which is scarcely more than the sixteenth of an inch long.

Thrips are well known to gardeners as being troublesome in frames, and they are also generally well known as the little black speck-like insects often seen wriggling actively about in flowers; often, too, by the annoyance they cause in hot weather by settling on the face, where they twist in all directions, holding on by their bladder-tipped feet, whence they take their German name of "Bladder-foot."

With the help of a magnifying-glass the perfect insect will be found to be blackish, a little less than one line long, the abdomen long, narrow, and smooth, with the tip bristly; the male without wings. The female has two pairs of long narrow wings, fringed with long hairs, and curving outwards, so that when they are laid straight along the body at rest the tips are apart. The feet are very short and stumpy, without claws.

The two earlier stages of grub and pupa much resemble the perfect insect, excepting that the grub is deep yellow, and has no wings; the pupa is of a paler yellow, with whitish cases for the wings which are not yet developed.

The above figure shows the female Corn Thrips at rest, and in the act of flying; and the figure of the Potato Thrips is added to show the difference in shape of the wingless condition.

The Corn Thrips lays its eggs on Wheat, Oats, and (speaking generally) on Corn and Grasses, and the insects may be

found as early as June in the ears, and also in the sheathing-leaves of the stem. The injury is caused by the Thrips drawing away the juices by its sucker-like jaw-apparatus, and thus the grain shrivels and becomes abortive.

Prevention and Remedies.—It is stated that Thrips do most mischief to late-sown Wheat, the early-sown crop being too hard at the time the Thrips appear for them to injure it, and though it appears quite impossible to do anything to check Thrip-attack when once established in the Wheat-ears (by reason of the minuteness of the insects), yet a good deal may be done in the way of prevention.

"The circumstance that Thrips are to be found in autumn (and still later) in large numbers in rotten roots, or in *stubble*, and in similar lurking-places, and also in the next spring before the development of the insect from the egg can have taken place, speaks for the hybernation of the Thrips in its perfect state, and also points to where attack comes from.*" The perfect insects are thus preserved, and next spring the females being furnished with wings, have full power to fly, or to be carried by any light breezes from their wintering places, to neighbouring Corn or Grass, where they will start new attack. Therefore, any measures for destroying their lurking-places would be sure to be of service.

Also these insects are to be found near marshes, and in the damp hot weather accompanying thunderstorms they have been noticed as especially injuring the crop in the part of a field to the north of a high hedge, and also the Potato Thrips, figured above, have been noted as most abundant on plants sheltered from the wind.

From these observations it would seem that a well-drained soil, properly cultivated and free from weeds, with surrounding hedges well trimmed down, so that the sun and wind might have free play, would be the best preventive, by inducing an early ripening of the Corn that would be beyond the power of the insect to injure, and would also do away with the damp close places which in some cases at least it has been found to infest.

Deep ploughing, so as to bury the Thrips well down, or dressings of gas-lime, or anything to poison the surface of the land, would be useful where the Corn was known to have been badly infested.

Removal of waste pieces or headlands of wild Grass would also be desirable, as these serve as propagating grounds, as well as winter shelters, from which the Thrips come out on the Corn.

* See 'Praktische Insekten Kunde,' by Dr. E. L. Taschenberg.

"*White-eared Wheat.*"—In 1888 a good deal of attention was attracted by a disease or attack to Wheat which gave it the appearance of being prematurely ripened, and soon became known as "White-eared Wheat." The heads were barren, and the top of the stalk within the sheath (in the advanced stage in which specimens were sent for examination) was usually severed across about three or four inches above the uppermost knot; so that though the injury did not show externally, yet by holding the lower part of the stem and gently pulling at the ear, the stem came out of the sheath, leaving a stump behind of a few inches long attached to the highest knot. This stump looked flaccid and shrunken, and at the point of severance, in almost all the specimens sent, the straw was shrunk.

The injury extremely resembled that caused by the maggot of the American Fly, the *Meromyza americana*, but there were no signs of this being present.

The cause of the disease could not be made out with certainty, but subsequent information from American observation of a very similar attack known as "Silvertop" in Hay, points to Thrips-attack being very likely the cause of the injury. (See Report of the Entomologist and Botanist, pp. 59—62 of Appendix to 'Report of the Experimental Farms, Canada, to the Minister of Agriculture, 1889.')

Tulip-root, or **Segging**, caused by "**Stem Eelworm.**"
Tylenchus devastatrix, Kuhn.

"Tulip-rooted" Oat-plant.

The disease known as "Tulip-root" in Oats takes its name from the swollen appearance of the base of the stem, which bears some resemblance to a Tulip-bulb, though still more to

a "duck-necked" Onion. This swelled stem is usually surrounded by a number of small doubled-up shoots, pale in colour, and bent to and fro, instead of being properly extended. The figure (p. 99) shows the appearance of an attacked plant as it is often seen; the disease is also known as "Segging," or "Sedging," from the Sedge-like appearance often assumed by the leaves. From the healthy growth of the plant being checked there is necessarily much loss both in straw and grain.

This disease has been much noticed of late years, especially in Scotland; and on investigation in 1886 I found Eelworms present in the bulb-like base of the stems, as well as in the spongy curled shoots; and from the resemblance of the diseased Oat-plants to the diseased appearance which is assumed by Rye when attacked by the Eelworm known by the name of *Tylenchus devastatrix*, it appeared likely that this Eelworm was also the cause of our attack; and on special investigation being made at my request, by Dr. J. G. de Man, of Middleburg, and Dr. J. Ritzema Bos, Professor of Zoology at the State Agricultural College, Wageningen, Holland (both well known for their minute and skilled research into the history of Nematode worms), this proved to be the case.

On examination of Oat-plants badly affected by "Tulip-root," or Segging, which I forwarded to Dr. de Man for his inspection, he wrote me that he found inside the lowest part of the stem a large quantity of living specimens of *Tylenchus devastatrix*, and a few days later, when he had examined more of the diseased plants, he further wrote that he had found in *all* of them large quantities of living specimens of this Eelworm.

Dr. J. Ritzema Bos also considered the above to be very characteristic specimens of the peculiar diseased growth under consideration, and on examination he found in them "a large number of *Tylenchus devastatrix*, males and females, larvæ and eggs."

Frequent examinations and careful study each season have confirmed these observations fully, as well as shown that this is one of the attacks which may with a little care be very much lessened or entirely prevented. Descriptions and magnified figures of the Eelworms will be found under the head of 'Clover-stem Sickness'; and in my 'Report on Injurious Insects' for 1889, fuller details are given, together with a full-page illustration of these Eelworms highly magnified, copied by kind permission from original drawings by Dr. J. Ritzema Bos.*

* For full information as to the habits of this Eelworm, plants infested by it, description, measurements, and excellent figures, in fact complete details, see 'L'Anguillule de la Tige,' par Dr. J. Ritzema Bos, Haarlem, 1888, and Part 2, 1889.

Prevention and Remedies. — Two practicable measures of prevention of recurrence of "Tulip-root" on infested land are to avoid crops that can be affected in the rotation, and to give deep ploughing; many of the Eelworms leave the plants as they die or dry from maturing, and lie in the upper surface of the soil; and if they are well turned down, much of the infestation will be got rid of.*

"The surest remedy for worm-sick fields is stated by Dr. Julius Kuhn, Director of the Agricultural Institute of the University of Halle, Germany, to consist in late ploughing, sixteen or eighteen inches deep.† By this treatment the upper layer of earth with the contained *Anguillulidæ* is buried deep, and is covered with a full spade's depth of the under soil. The treatment must be carried out in autumn, and in the next spring cultivation, rich manure given to the crop. It is most desirable that this should *not* be of stable manure, which it is very possible may contain Eelworms, but rather of guano and superphosphate. Carrots and Potatoes succeed best in the late-ploughed land. Should, notwithstanding, the worm-disease appear again at the same places in the fields, the spots should be dug anew deeply, two spades deep; we can also prevent the spread of these wormlets by isolating, by means of a trench of a foot and a half deep and a foot across."—(J. K.)

With regard to different methods in which the wormlet infection may be spread, it is shown by Dr. Kuhn that one way is in earth from infested fields. This is shown by an instance in which a man, to mark his disbelief in the possibility of such transmission, had earth from Eelworm-infected land spread on what was clean before, and thus set up attack. It is also noted that the infection may be spread in earth *carried* from infested land (that is, by earth adhering to agricultural implements, to the hoofs of horses employed on the foul land, or to the shoes of the agricultural labourers).‡

This kind of Stem-eelworm possesses enormous vital powers, and may be passed through an animal feeding on infested fodder without being injured by processes of digestion. Also, if kept in a dry state, even for several years, these *Tylenchi* will regain their vital powers on being

* This has been observed to happen in the case of stem-sick Rye by Dr. Ritzema Bos; and as the habits of the wormlet and its effects were precisely similar in its attacks on Oats, it is presumable that this happens also in the case of Tulip-root attack.

† A moderate depth of ploughing, such as can be carried out with a plough with skim-coulter attached, will do much good if the surface-slice is well turned down, as it is mainly in the surface of the land that the wormlets which have left the plants lie.—E. A. O.

‡ See the work 'Ueber die Wurmkrankheit des Roggens,' &c., von Dr. Jul. Kuhn, Halle, 1869.

moistened. Consequently, manure made from infested fodder, whether Straw, Clover, or other plants, ought not to be carried to fields where crops are to be grown which are liable to attack. Likewise it is desirable to collect and burn the stubble remaining on the ground, in order to destroy in it all the wormlets which may have remained, and also all the *Tylenchus* eggs.

Amongst Corn crops, Oats and Rye are especially subject to attack. Wheat can take it, but as far as we have seen does not suffer much.

Clover is excessively liable to attack of this Stem-eelworm, and Buckwheat also and Teazels, both wild and cultivated.

Onions suffer much from the infestation in Holland, but have not yet been reported as injured in this country.

Various kinds of meadow plants and Grasses are liable to attack, as Daisies, Buttercups, and the Ribwort Plantain; also the Sweet-scented Vernal Grass, Annual Meadow Grass, and Meadow Soft Grass.*

Barley appears to be perfectly free from infestation, therefore is useful in rotation, and the ordinary field crops (with the exception of those specified above) appear safe practically, although there may be doubt as to what time may show as to Potatoes, and I have myself infested Turnips by sowing seed on earth in which I had buried Tulip-rooted Oats or Rye.

Clover after Tulip-root, or Oats after stem-sick Clover, should be most carefully avoided.

Special applications which have been found most serviceable as manure in the preparation of the land, or as dressings to bring an infested crop over attack, are sulphate of potash alone, or as a mixture with sulphate of ammonia and phosphates.

In one special case reported of Tulip-rooted Oats in Mid Lothian, in 1888, a top-dressing of about 1 cwt. per acre of sulphate of potash was given, with the result that the disease disappeared, and an excellent crop was cut.

In another instance regarding Tulip-rooted Oats (in fields from which specimens of stem-sick Clover had been sent me in the previous year) the manure applied consisted of phosphates, ammonia, and potash when sown, at the rate of 3 cwt. per acre. This produced a very luxuriant growth, with the exception of a sandy knoll. These knolls are noted as being especially subject to Tulip-root.

The following detailed note, sent me in the course of experiment carried on for several years with much care, regarding Tulip-root prevention, by Mr. J. Elder, of The

* For most recent list of plants liable to infestation, and amount, see work by Dr. Ritzema Bos already quoted.

Holmes, Uphall, Linlithgow, N. B., on June 15th, 1888, shows that at that date "The unmanured land was giving the most unhealthy crop; that with steamed bone-flour came next; the plot treated with sulphate of ammonia had a number of unhealthy plants, but was better than what was unmanured; and of the two others, both were doing very well on the whole, but that treated with the mixture of sulphates and phosphates was better than that treated with sulphate of potash alone.

"No. 1. *Steamed Bone-flour*, 3 *cwt. per acre*, got very yellow for a while, but has now taken on a growth; a number of unhealthy plants on this plot.

"No. 2. *Sulphate of Potash*, 55 *per cent.*, 3 *cwt. per acre*, was always fresh and green, and not an unhealthy plant on the whole plot; it is now, however, losing growth a little.

"No. 3. *No manure*, has always been the worst, having a great number of unheathy plants, and a sickly yellow appearance. It is now mending a bit.

"No. 4. *Sulphate of Ammonia* $1\frac{1}{2}$ *cwt. per acre*, has also a number of unhealthy plants, though not so bad as No. 3. It has now taken on a luxuriant growth.

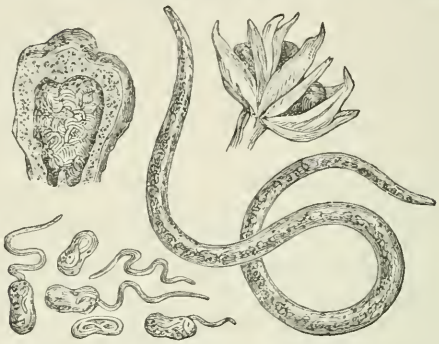
"No. 5. Mixture" (consisted of about 2 parts of sulphate of potash, 55 per cent.; 3 parts of sulphate of ammonia, 25 per cent.; and 4 parts of phosphates, 48 per cent.) "has been similar to No. 2 all spring, perhaps not quite so dark a green. Plants healthy, with few exceptions. Gives promise of being the largest crop of any of the plots."

In experiments carried on in the preceding year, 1887, by the same observer, the application of $\frac{3}{4}$ cwt. of sulphate of potash per acre, in addition to superphosphate and ammonia, is noted as so marked, that the supply having run short before the field was finished, the part that received the potash grew on most luxuriantly, but the rest threatened to be a complete failure.

Nitrate of soda, at the rate of 1 cwt. per acre, is noted as doing *no good*, and after a fortnight of "growing weather," bringing no improvement. Sulphate of potash, at the rate of about $\frac{1}{2}$ cwt. per acre, brought good growth and a heavy crop harvested.

Dr. Kuhn concludes his valuable pamphlet, previously quoted from (at p. 101), with the following summary: — "Deep cultivation, rich manure, but with care not to use wormlet-infested stable manure, and suitable rotation of crop, are the best methods of combatting the evil; their application consistently carried out will be certain to succeed in time."

"Ear-cockles"; "Purples"; "False Ergot"; Galls of Wheat Eelworms. *Tylenchus tritici*, Bastian; *Vibrio tritici*, Bauer.



Wormlets escaping from eggs; section of Cockle-gall, with wormlets within; after Bauer's figs. (much magnified). Spikelet of Wheat, with galls (magnified). *T. tritici* wormlet (greatly magnified), nat. length of largest about one-fourth inch.

This paper is placed immediately after that on Tulip-root, as the diseased growths known respectively as Tulip-root, and Ear-cockles, are in each case caused by presence of Eelworms of the genus *Tylenchus;* in one case by the *T. devastatrix*, in the other by the *T. tritici*.

Cockle-galls, or "Purples," are the small roundish or distorted growths, sometimes found in Wheat which give an appearance to the ear much as if purplish or dark coloured peppercorns had taken the place of the Wheat grains. Sometimes they are present in great numbers, as in 1886 when a bunch of Wheat almost ruined by the amount of Cockle-galls present was sent me from near Cirencester, with the note that there was presence of this gall attack in Wheat in three fields covering together about twenty-seven acres; but this amount of infestation appears to be quite exceptional.

On splitting one of the galls and placing it in a drop of water, the vast number of wormlets within (which were all collected together, as shown in the section of a Cockle-gall figured above magnified) swelled up and overflowed in countless numbers on the microscope slide.

The method of spread of attack as quoted by Dr. Charlton Bastian, from M. Davaine's experiments, is that when the infested galls are sown, these galls become softened, and the wormlets within, thus being able to escape, make their way to the young sprouting plants, "and then insert themselves between the sheaths of its leaves, gradually working their way round till they come to the innermost of these, where they remain for a variable time, without increasing much in size,

till the rudiment of the future ear begins to form." Whilst this is still so young that the future portions of the flower are not yet distinct, and are still of soft cellular tissue, the wormlets introduce themselves within these portions, and the gall-like growth of "Cockles," or "False Ergot," is the result. The "young worms soon become perfectly developed males and females. These vary in number from two to twelve in each gall, and, after producing an enormous number of ova [eggs] containing fully-formed young (which speedily liberate themselves, though they afterwards undergo little change), themselves die and wither at the time when the gall begins to assume its characteristic black or brown appearance."

The above is partially quoted, partially abridged, from Dr. Bastian's account of his own observations, and those of Davaine.*

The figures (p. 104) give the mass of worms in a Cockle-gall, and also the worms just escaping from the eggs, all greatly magnified. It is difficult to convey any exact likeness of the wormlet itself at this size on wood, but the figure gives the general shape, and the upper end shows moderately the spear or proboscis in the mouth-end, though not its three-lobed base; also the rounded muscular swelling just below, which is one of the characteristics of this species; and the coarse fat granules in the intestine. The colour is yellowish white, and the largest wormlets are from a seventh to even a quarter of an inch in length.

Prevention and Remedies.—It is stated by Dr. E. L. Taschenberg that these wormlets are destroyed at once by the effect of acid or metallic salts, and it is mentioned that the well-known steep of sulphate of copper, likewise of dilute sulphuric acid, are of use in killing the wormlets in the "Cockle"-galls, and thus preventing infection being sown with the seed. Of course, as in all other cases, care must be taken that the steep is not strong enough to injure the growing power of the seed.

The method of application is to place the Corn in a vessel with the steep so that the liquid shall be a little above the surface of the Corn; then stir the Corn gently, and skim off the galls ("Cockles") that rise to the surface. Thus, as Dr. Taschenberg aptly remarks, "we kill two flies with one blow." †

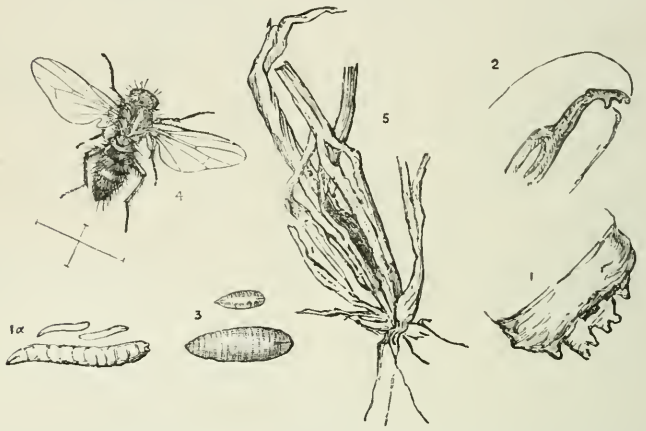
It would be desirable to avoid use of manure for Wheat-fields which had in it dung of fowls or other animals which had fed

* "Monograph on the Anguillulidæ," by H. Charlton Bastian.—'Trans. Linn. Soc.,' vol. xxv., pp. 87, 88.

† 'Praktische Insekten Kunde,' von Dr. E. L. Taschenberg, pt. v., p. 171.

on screenings in which Cockle-galls were mixed, and which would consequently be almost certainly infested with the Gall Eelworms.

Wheat-bulb Fly. *Hylemyia coarctata*, Fallen.



Wheat-bulb Fly (*Hylemyia coarctata*), magnified, and lines showing nat. size; maggots and chrysalids, nat. size and mag.; mouth-apparatus, and extremity of tail, with tubercles, mag.; infested plant.

The attacks of the maggots of the Wheat-bulb Fly and those of the Frit Fly (noticed at p. 73), are much alike so far as method of injury is concerned. In both cases the injury to the plants is caused by the maggot feeding within the young stem, and thus causing the death of the infested shoot from the joint effect of the gnawing of the maggot and the consequent decay of the attacked part; and the two kinds of whitish maggots also look very similar to the naked eye, but when examined with even a moderately powerful glass the differences may be clearly distinguished. The Wheat-bulb maggot thus seen is whitish, legless, cylindrical, and somewhat lessened towards the head end, which is furnished with two black mouth-hooks. The tail extremity is furnished above with two black spots, which are the *spiracles* (or breathing-pores), by which air is drawn into the very observable *tracheæ* (or air-tubes). Beneath, that is at the lowest part, the tail segment projects, and ends in two squarish-ended teeth with flattened edges placed centrally, with one pointed tooth, and sometimes more on the outside of the central square pair. When seen with a higher power the teeth appear as fleshy projections (see figure 1), and the ends of the two central

teeth, instead of appearing square or a little curved-in, appear noticeably indented. The presence of these teeth and the *absence* of a little bunch of *stalked spiracles near the head* appear to me to be the simplest way of knowing the Wheat-bulb from the Frit maggots.

The chrysalids are of the size and shape figured at 3, p. 106 (nat. size and magnified), that is, somewhat oval, thickest at the head end, and of a medium shade of brown, with the spiracles still projecting, and always very plainly noticeable at the tip of the tail, in the form of two little knobs.

The flies are two-winged, and not altogether unlike the well-known Onion Fly in general appearance.

More particularly noticed, they are as described by Mr. R. H. Meade: Males with the thorax grey, the sides lighter, and the *dorsum* (back) indistinctly striped; the abdomen hairy, oblong, narrow, flat and cinereous, with an indistinct narrow dorsal stripe; anal segment grey; subanal appendages hairy, with two black lamellæ; wings with narrow veins; legs black, with pale *tibiæ*. The females have both the thorax and abdomen pale ash-grey and immaculate, and the four posterior femora, as well as the tibiæ, pale.*

The maggots may be found far enough advanced in size about the beginning of April to be destroying the young Wheat-plant; at the beginning of May I have had consignments of specimens with fat, strong maggots upwards of a quarter of an inch long, one maggot lying lengthwise in each stem examined and nearly filling it up. During May they ceased feeding; towards the latter half of the month they were turning to chrysalids (leaving the plant, to change in the earth), but the Fly itself did not emerge until the beginning of July from chrysalids which were being kept under observation, though, judging by dates given in German observations, it is likely that it would take a much shorter time to develop when in natural circumstances.

The attack of this Wheat-bulb maggot was first certainly identified in 1882, though there is good reason for believing that it was present to a serious extent before; now it is one of our regularly recognised Wheat-plant pests. In 1888 packets of infested plants were forwarded to me for examination almost daily from about the first week until the end of May. The localities from which attack was reported were mainly in the Midland and Eastern Counties, extending as far north as Darlington in Durham, and as far south as Almondsbury in Gloucestershire.

The amount of injury was reported by various corres-

* "Annotated List of British Anthomyiidæ," by R. H. Meade. 'Entomologists' Monthly Magazine,' March, 1882.

pondents in that year as very severe; sometimes every plant being destroyed for yards together, or a complete failure in various places, and in the Fens "hundreds of acres being eaten off"; also that near Warrington, "for several miles around, both in Cheshire and Lancashire, the Wheat-crops in some fields have been greatly damaged, in some entirely destroyed."

Prevention and Remedies.—In continental observations the Wheat-bulb maggot is given as attacking Rye; otherwise Wheat appears to be the only crop infested by it; but the only method of prevention of attack which appears to be known of at present is not to sow Wheat on land of which the preceding summer conditions have been observed to be specially followed by this kind of maggot attack, though *why* we do not yet know.

It is very remarkable that from the beginning of observation of maggot in the young Wheat-plant, about 1880, before the attack had been certainly identified, as well as since, where we have been quite certain of the pest, the attack has been specially found to follow on fallow. In a report given me by Mr. Parlour, of Middle Farm, Dalton-on-Tees, near Darlington, in 1888, he mentioned, "I have examined several fields in the district, and find that *almost all fallow fields have suffered more or less*." "In no case, so far as I can find out, has any Wheat been attacked where the land was cropped last summer." In 1882 Mr. W. Creese, writing from Teddington, near Tewkesbury, regarding this attack (of which specimens had then been trustworthily identified), observed that it attacked plants on land that had been fallowed in the previous summer, but did not appear on land ploughed for the first time in the autumn; also that it leaves a belt of four or five yards near the *edge* untouched. In 1881 Mr. B. Brown, of Deard's End, near Stevenage, wrote regarding a maggot infestation which appeared to be similar to that under consideration, that it attacked some portion of his Wheat there, sown after dead fallow, and its ravages were so great that he discontinued planting Wheat after fallow. The Wheat looked well until after *Christmas*, but began to die off in the spring months.

The special reports of 1888 and 1889 mention the attack as being most commonly observed after fallow, and after Turnips or Swedes, or *where a portion of these have failed*, or sometimes after Potatoes *where they have been raised before they are ripe, or raised early*, or had thin amount of leafage.

The above is the only clue that we appear to have at present to prevention. It appears very possible that Couch Grass or

other wild Grasses would sprout in the fallows, or on the bare patches of Turnip-fields, or in the early-turned Potato-fields, and in the young shoots of the Grass, the Wheat-bulb Flies which come out in the beginning of July might lay their eggs. It is *against all likelihood* that the identical flies which appear in July should live on to lay their eggs from October to March, *but very likely* that they should lay them on wild Grasses during July, or at least shortly after they appeared; and the maggots from these eggs turning in regular course to chrysalids and thence to flies, these would be ready to start attack on Wheat following on the same ground. The following observation may also be worth notice:—"It is also to be remarked that the tops of the ridges (*i. e.*, where the soil is the hollowest, from the plough having thrown up the two ridges together from opposite directions) are more affected than the ridges below these or in the bottom." In this case the hollowness would be more favourable for escape of the flies from the chrysalis than the solidly laid earth.

Wheat, on land dressed with pond mud, has been found to suffer more from the attack than other parts of one field specially reported on; but at present no remedy appears to be known. The only special treatment which has been suggested is a very thick seeding on all lands where attack is feared; if the crop escapes and is considered to be too thick on the ground, a portion of the plants can be harrowed out.

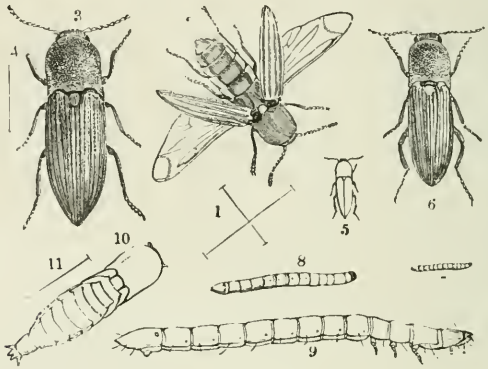
Wireworms (Grubs of Click Beetles).

Elater (*Agriotes*) *lineatus*, Linn.
,, ,, *obscurus*, Linn.
,, ,, *sputator* (Linn. ?), Fab.
,, (*Athöus*) *ruficaudis*, Gyll. (*hæmorrhoidalis*, Fab.)

Wireworms may perhaps be said to do the greatest amount of mischief of any of our farm pests; they destroy root, grain, and fodder-crops. From their method of gnawing the roots or underground shoots, and then going on to another plant, they waste and destroy far more than they need for food; and as they live for several years as grubs, and feed during these years on almost every kind of crop that is commonly grown, their ravages are of a very serious kind.

The Wireworm is the grub of the long narrow greyish-brown, or blackish beetle (see figs. 1—6, p. 110), often seen during summer in Grass-fields, commonly known as the Skip-Jack, or Click Beetle, from its power of regaining its position, when laid on its back, by a spring or skip, accompanied by a sharp click.

Figs. 7 and 8 give the size of two kinds of these grubs which are called Wireworms, from their likeness in toughness and shape to a piece of wire. Like it they are very smooth and shining, and somewhat cylindrical; but a little flattened, so that (like a wire that has been pressed by a weight) they have a blunt edge at each side. The colour is usually ochreous-yellow, turning to a darker tint after death.



1 and 2, *E. lineatus;* 3 and 4, *E. obscurus;* 5 and 6, *E. sputator*, nat. size and magnified; 7, larva of *E. sputator?;* 8 and 9, larva of *E. lineatus*, nat. size and magnified; 10, pupa of Wireworm (lines show nat. length).

The Wireworms have three pairs of short legs, one pair of these being placed on each of the rings immediately behind the head, and they have also a sucker-foot below the tail.

The egg from which this grub is hatched is laid either in the earth close to the root of a plant, or between the sheathing-leaves, or amongst leaves near the ground. On being hatched, the grub or "Wireworm" eats into the stem just above the true root, about an inch below the surface of the ground, and sometimes eats its way up the middle of the stalk, even above the surface of the earth.

The Wireworms are said to live five years in the grub state, but the length of time probably depends on the supply of food. Where they are well fed, it is supposed that they only take about three years before changing to the pupa. But however this may be, with the exception of any temporary pause in winter (when they go down deeper and deeper into the ground as the frost increases), they feed voraciously, near the surface, till the time has come to turn into the chrysalis (or pupa). Then they go deep into the soil, and form an earth-cell in which they change, and from which the perfect beetle comes up through the earth in two or three weeks, probably appearing about the middle of summer; or they

may pass the winter in this state, and the beetles develop from the chrysalis in the following spring.

Of the many kinds that are to be found of these beetles, only four are noticed as being particularly hurtful to crops. These were formerly all known scientifically as different species of *Elater*. *E. sputator*, fig. 5 (and 6, magnified), p. 110, is the smallest. It has the head, and part of the body behind it, black; legs rufous; and the wing-cases dusky.

E. obscurus (fig. 3, magnified) is larger and pitchy, covered with ochreous down or hairs, so that perfect specimens appear dull brown all over, and rubbed ones blackish. It has black thighs, and the shanks and feet rusty.

E. lineatus (fig. 2, magnified) is very like the preceding, but greyer; it has the wing-cases striped, and the legs rusty red. The Wireworm of this species is often found in dung and vegetable earth.

These three kinds are now generally known as *Agriotes*, instead of *Elater*.

The fourth species, now known as *Athöus*, has its special name of *ruficaudis*, from the red colour of the abdomen and tail; this is larger than the others.

These four kinds of Click Beetle are, however, alike in all important points in their manner of life.

Elater (*Agriotes*) *obscurus*, nat. size and magnified.

The reader is particularly requested to notice the figure and description of these grubs or larvæ, that is, of *the "true Wireworm,"* that he may distinguish it from the grubs of other insects which are not altogether unlike it, and from insect allies which pass under the name of *false Wireworms*.

The Wireworm has *six* true legs; this distinguishes it from the grubs of the Daddy Long-legs, or Crane Fly (Leather Jackets), which have *none*. Also, the Wireworm has *only* six legs (besides the sucker-foot at the end of the tail); this distinguishes it from the Millipedes, which have many, excepting when first hatched.

Prevention and Remedies.—Broken-up pasture land and Clover-leys often swarm with these most destructive grubs, and it is from this infested ground that the most serious damage arises.

*The first point in measures of prevention is such treatment of pasture or ley by close grazing, treading with sheep, dressing with lime, gas-lime, salt, &c., as may best prevent the Click Beetles laying eggs, or may destroy such eggs or Wireworms as may be in the soil before the land is broken up; also various methods of ploughing and consolidating the land, and of paring, burning and cleaning out roots and rubbish, and of cropping and manuring, suited to destroy or starve out the Wireworms; and to promote a hearty good growth of the next crop.**

The following are some of the measures especially advised:—

"Feed down the land as bare as possible before ploughing it, and leave as few stumps of Grass as possible or leaves to plough in. I believe a top-dressing of lime, or lime and salt to the land, after it is eaten down bare, and before it is ploughed, would also tend to check the Wireworm. After the land is ploughed, roll it down as tight as possible." —(M. Locke Blake, near Ilminster.)

"In order in some degree to prevent mischief from this pest, it is well to consolidate the surface thoroughly, and to graze every bit of plant off all leys or pastures which it is desired to break up. For this purpose sheep and cattle should be fed with cake, Corn, or other feeding stuffs, so that each inch of land shall be trodden and eaten bare. By this means the grub would be destroyed, or if it escaped being trodden to death it would find great difficulty in obtaining food, both through the scarcity of vegetation and the solidity of the surface soil.

"A dressing of gas-lime on the surface and ploughed in has a good effect on any of the worms which may have escaped the treading and starving."—(Adam Lee, for the Right Hon. the Earl of Powis, Lydbury, N. Shropshire.)

"If the lea is broken for Oats (our general crop), it is sure to be attacked more or less by Wireworm; I top-dress with 4 cwt. agricultural salt, 2 cwt. superphosphate, and sometimes 1 cwt. nitrate of soda. I have never found this to fail if applied in time. If the lea is broken in the autumn, to have green crops in the following year, I have the land worked as much as possible, and apply 8 tons hot lime to the statute acre; lime as hot as possible. I always sow the seed

* A portion of the information in this paper is taken from notes contributed in reply to a circular issued by the Council of the Royal Agricultural Society of England, requesting information as to the habits of Wireworms and methods of prevention of their ravages, which were formed by myself as the Entomologist of the Society into a Report published in their Journal for 1883, vol. xix. part 1, and reprinted (by permission) in my own 'Annual Report on Injurious Insects' for 1882, published 1883. The more important of these extracts are distinguished by the name and address of the original contributor.—Ed.

with a liberal dressing of farmyard dung, for such crops as Mangold, Turnip, Cabbage, Carrot and Parsnip, and I use the following dressing of artificial:—2 cwt. best bone meal, 1 cwt. nitrate of soda, and 3 cwt. common salt. I find the plants are soon forced up beyond the reach of damage."

"On the old red sandstone formation I find lime absolutely necessary. I do not think 8 tons per acre is quite enough, and would use 10 tons if I could procure it quickly."—(Sir Richard Keene, Cappoquin, Waterford.)

"In preparing lea for Oats I either top-dress the surface with lime or by sheep. When by lime, I prefer to draw the lime daily as it leaves the kiln, and put it down in heaps which I cover with earth. The heaps are small and placed conveniently for spreading. They are allowed to remain until the stones are pulverised, and then the lime is spread in the hot state over the surface. The effect of hot lime is to burn off the Grass, and thus to destroy the food of the Wireworms; also when (as is well known) they come to the surface after freshet, they do not do well amongst the lime. Further, I am of opinion that this system of top-dressing has a good effect in destroying eggs from which Wireworms would have hatched. I use from 60 to 80 barrels of lime (measured before pulverised) to the Irish acre." *—(S. Sym Scott, Ballinacourte, Tipperary.)

Salt is considered a useful preventive if applied in *moderate quantities before breaking up ley, or in a heavy dressing if applied some weeks previously.*

"Salt at the rate of 5 or 6 cwt. the acre on light land is considered useful if sown before breaking Sanfoin or Cloverley."—(J. Addison, near Basingstoke.)

"An old ley was dressed with 10 cwt. of salt per acre in the autumn, and the salt ploughed in. This plan not only killed the Couch and Twitch, but on this piece of land there was no trouble from Wireworm or from grub, and none has been known to occur since."—(Per C. E. Curtis, Alton, Hants.)

"I have known a heavy dressing of salt, 10 or 12 cwt. per acre, applied some weeks previous to sowing to have a good effect." The observer noted that where old and poor Grassland on light soils was ploughed up, this offered every facility for action of Wireworm, and—"The general treatment is to lime and salt liberally and to tread the land by consuming the root-crops with sheep. On the other hand, I have known strong loam, rich with farmyard dung and artificial manure but *without lime or salt*, suffer severely." — (D. Rowland, Titley, Herefordshire.)

* 100 Irish acres are equal to 162 English acres, consequently an Irish acre amounts to one acre and three-fifths English measurement.

Gas-lime acts well as a deterrent of attack, and where the land can be left untouched for a month or six weeks, a dressing of it in caustic state is valuable, by reason of its killing all it touches whether vegetable or insect.

"For several years a portion of one of my fields was infested with Wireworms, and in spite of Rape-cake and other supposed remedies every successive crop was more or less injured, until one autumn I ploughed in refuse gas-lime, and from that time have never seen a Wireworm in that field."—(The Right Hon. the Earl of Essex, Cassiobury, Watford.)

"I do not think we are much troubled here with Wireworm, except in very old pastures, and then our usual plan is ploughing up and dressing with gas-lime." — (W. Eliott Lockhart, Hawick, N. B.)

"For Clover-leys I should put about 10 cwt. of gas-lime to the acre, and then plough it under. I think this is a great preventive. If used for Turnips sow it on broadcast and work it in, and then add what may be thought best for the crop."—(S. Massey, Church Lawton, Cheshire.)

"I dressed a few acres with gas-lime in March, and it seems to have freed the ground wonderfully."—(John Heatley, Passingham, Wolverhampton.)

"Some years ago complaint was made of the destruction of grain crops on a limited portion of a field of rather light soil. I advised the trial of gas-lime, and several cartloads were applied, with the result that not a trace of Wireworm was seen for several years after."—(Jos. Ellans, Anglesey.)*

Kainite in amount of 3 cwt. per acre, and (in another instance on stiffish soil) at the rate of 4 cwt. per acre, and nitrate of soda at the rate of about 2 cwt. per acre are also noticed as dressings which have been serviceable in preventing Wireworm attack; a caution is given by one sender "to apply the salts when wet, otherwise there is a risk of burning the plants."

Paring and burning is a good practice, so far as getting rid of the grubs is concerned, as great numbers of the grubs and other insect-vermin are thus destroyed, and also a large amount of the live Grass-roots and weeds that might feed such grubs as remained in the ground. The rubbish should be burnt as soon as possible, or the Wireworms will quickly leave it, go down into the earth and escape. The habit of the Wireworm to go down deep—even as much as a foot below the ground in winter—should also be remembered,

* Notes as to the amount of gas-lime considered by the late Dr. Aug. Voelcker (Consulting Chemist to the Royal Agricultural Society of England) as safe for application per acre, together with observations as to requisite caution in use, &c., and reference to Dr. Voelcker's paper "On Composition and Use of Gas-lime in Agriculture," are given at p. 37.

as a paring that would clear off a large proportion of the Wireworms in warm weather would very likely pass above almost all of them in winter, and leave them uninjured to come up to the surface in spring.

A summer fallow, and burning all rubbish on the ground, is also recommended. By this means the grubs at the shoots are destroyed at once, and those in the ground die for want of food.

Strips of Grass or Clover should not be left growing in the field, or at the sides, for the Wireworms feeding in these will spread themselves round and damage the neighbouring crop.

Such methods of cultivation as will ensure a strong healthy growth are of great importance; the Wireworms injure and weaken a great deal more than they destroy; and if the soil is so prepared as to ensure healthy germination of the seed, and vigorous growth from the first, the plants will push on and get over the attack, where weak plants would sink under it.

Drilling manure with the seed will help in this matter. Probably any manure that acts rapidly will be of service, but Lawes's Turnip-manure has been found to answer well with Barley on a badly-infested piece after dead or bare fallow, the parts of the field not thus treated having more than half the plants destroyed.—(B. B.)

A mixture of guano with superphosphate of lime, drilled with the seed on pasture-land broken up the previous year, has similarly brought a good crop, whilst the rest of the plants on the field perished by Wireworm. Dissolved bones drilled with the seed also do good.

Soot and also guano have been found to stop the mischief in bad attack on Oats. The soot was applied at the rate of sixteen bushels per acre, the guano at the rate of two hundredweight, "all in a pouring rain." Many of the patches that were apparently destroyed put out new roots at about half an inch below the surface, and the crop was excellent.

In this case there would be benefit from the manure being washed down into the soil for immediate use, and if on the first signs of attack, before the strength of the plant is gone, any kind of liquid manure that may be preferred was applied *at once*,—by the liquid manure-cart, where this is practicable, —it would do much good, partly by driving some amount of the Wireworms away, but chiefly by giving the plant strong food in a form that it could take up at once, and so counterbalance the lessened supplies conveyed up the partly-eaten stem.

Any stimulating manure, whether chemical or otherwise, suitable to the soil, which is easily soluble by rain and which would thus come quickly into action, would be of service.

Superphosphate for Turnips and nitrate of soda for Corn crops have been specially recommended, and the nitrate given at a rate of 2 cwt. per acre, and a mixture of the nitrate and common salt, in proportion of 1 cwt. of the first to 2 cwt. of the second, have also been found useful in pushing on the young crop, or saving it when attack was present.

A mixture of 2 cwt. of Rape-cake, 2 cwt. superphosphate, and 1 cwt. kainite, is noted "as a good fertiliser for Wheat, when sown broadcast at the time of drilling the seed; this carries the plant out of reach of attack and gives a satisfactory return on all light soil. On clay it is useless."—(Ralph Lowe, Sleaford, Lincolnshire.)

The application of Rape-cake, nuts or meal, acts well in lessening amount of injury, both by fertilising the land and attracting the Wireworm from the plant.

The cake has been found of use applied at the rate of 5 cwt. per acre, crushed into about half-inch lumps and mixed well with the soil.

Rape-dust of Indian or Kurrachee cake, which is formed from Mustard-seed, has answered well, whether drilled with Oats or together with Turnip manure. In one special case the following note was sent:—"About the application of Rape-dust to the land to destroy Wireworm, I may say that in 1874 I got two tons of very fine Rape-dust—as fine as flour. I mixed it up with the Turnip manure, and sowed it in the drills in the usual manner. The result was very good. There was no Wireworm, and the crows did not look for any, but on about an acre of the field that got no Rape-dust the worm was bad and the crows pulled the Turnips. In 1875 I used three tons with the same good result. Of course it has a certain value as manure as well."—(Edw. Gordon, Mains of Kelton, Kirkcudbright, N. B.)

In my own experiments I have found that Wireworm supplied with nothing but the moistened Kurrachee cake for food died in about a fortnight, whilst those supplied with only the true Rape-cake, moistened like the other kind, were still alive upwards of three weeks after being placed in it, and showed no signs of ceasing to thrive.

Pressure of the land, by rolling or by treading with sheep, or other measures calculated to compress the soil firmly, and thus keep the Wireworm from travelling, are strongly recommended both for prevention and remedy when attack is present.

"Rolling after sowing is generally admitted to be the best preventive. By rendering the soil firm and compressed it prevents the ready passage of the Wireworm from plant to plant, and thereby localises the damage. Where crops are affected, rolling or treading by sheep where practicable is a

plan universally adopted, and is, I think, the best remedy."—(David Rowland, Titley, Herefordshire.)

"Our treatment of land, where crops are affected, is frequent use of a heavy ring-roller, and steady driving of sheep backwards and forwards over the land."—(J. Forrester, for the Right Hon. Viscount Portman, Bryanston, Blandford.)

"If the Wireworms attack a crop the only way I have found to stop them is to get the land into as firm condition as possible; if the land is open they can travel easily from plant to plant, and may often be seen working up a drill and killing all the plants in succession."

"If the land is firm and hard pressed the Wireworm has more difficulty in working about in it. *Rolling* constantly with a heavy roller, or turning *sheep* backwards and forwards on the ground, is the only way to get it properly consolidated."—(M. Locke Blake, near Ilminster.)

"Wireworms are more active in the spring months after a long frost (on account of the land being more porous then) than they are in mild winters."

"I have used thirty cwt. of gas-lime to the acre on Cloverley, and harrowed the land a week or nine days before being ploughed up for Wheat, with good effect, and put the shepherd to drive the *sheep close over* the field when the drill was planted. In March, if the land is dry enough, put *cattle and sheep to tread it* and roll down. I do not think rolling does as much good as the horses do in treading, especially if they are driven three abreast."—(G. Burgiss, manager to the Right Hon. Earl of Winterton, Strutherglen Park, Petworth.)

In the space now available it is impossible to enter in anything like full detail on the many points which bear on prevention of Wireworm attack, but in the foregoing pages examples are given of different ways in which the most important of these may be carried out, namely, treatment and applications to prevent egg-laying, or to destroy Wireworms, in pasture or ley before or during the operation of breaking it up; treatment of land and manurial applications suited to push on good growth, so as to carry the plants "past" attack; and treatment, when attack is found to be present, which may lessen the amount of injury going forward by measures such as compression of the soil or applications which may attract the Wireworm from the plant.

Special observations regarding treatment for Wireworm prevention amongst Hops, to which crop the *P. concinna* (the Hop or Tooth-legged Flea Beetle) is often injurious, are given under the head of "Hop."

Amongst root-crops, drill-hoeing, horse-hoeing twice in a place, hand-hoeing close to the rows, and chopping out to stop

the progress of the Wireworm along the drills, are measures found more or less serviceable; here the object of the treatment is, by stirring the soil, to encourage the growth of the plants and to harass and disturb the Wireworm.—(E. A. F.)

This also throws the land open to help from the birds. Rooks, starlings, plovers, peewits or lapwings assist in keeping down the Wireworm. Partridges also, and pheasants, help in the work, but damage to the plants in search for the "worm" at the roots has to be considered where birds are too numerous.

Rotation of any ordinary crop is of little or no use as a means of Wireworm prevention, excepting with regard to *Mustard*. A crop of Mustard, "allowed to grow to a considerable length"; or to "about a foot or eighteen inches high," or "allowed to stand until it comes into flower" and then ploughed in, or a crop of Mustard (simply mentioned without special details), was strongly advised by contributors to the Royal Agricultural Society's Report before quoted from, as serviceable for preventing attack, also cleaning *after fallow*. "There is no crop that increases Wireworm so much as 'Couch' and weeds; and often, when land has been fallowed the previous summer, the Wireworms are quite as destructive in the next spring as they are on the Clover-ley Wheat."—(G. Burgiss, The Farm, Strutherglen, Petworth.)

In garden-cultivation, one exceedingly important means of prevention is to avoid the use of infested turf. The broken turf should never be used without having been thoroughly examined so as to make sure there are no Wireworms in it. If it is only wanted in small quantities, this can be easily done; the turf can be broken by hand into small bits, so that its state can be seen.

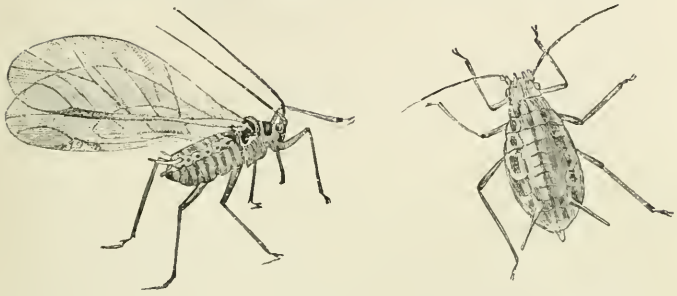
Where a large quantity is wanted, it is a good practice to throw the turf in a heap after being mixed with fresh gas-lime, a dressing of gas-lime being also spread over the heap.

The sulphide which is present in *fresh* gas-lime will kill all vegetation and insects, and by the time the turf is required for use it will be converted by the action of the air and moisture into sulphate of lime (gypsum), which is serviceable in various ways as a manure.

If turf-heaps are allowed to get covered with Grass, it is of no use, so far as getting rid of Wireworm is concerned, to have them at all; for these grubs will be as perfectly well suited there as in the field. If we are to get rid of the Wireworm feeding at the roots, we must get rid of the growing Grass or plants, and any treatment is good that brings this about, whether it be turning the heaps, liming, burning, or otherwise.

HOP.

Hop Aphis. *Aphis (Phorodon) humuli,* Schrank.



Aphis humuli : winged and wingless viviparous females, magnified.*

The Hop-plant has many insect-foes. Chief amongst these is the Green Fly, or Aphis, which in some seasons causes the almost total destruction of the crop of Hops.

1 2

Hop Aphis: base of antennæ and frontal tubercle of — 1, young form; 2, wingless female, magnified.

The general appearance of these pale green Aphides is too well known to require description, but it may be observed that the genus *Phorodon,* to which they belong, is distinguishable from others of the *Aphidinæ* by the horns being hardly longer than the body, together with the lowest joint being toothed or gibbous, and the tubercles on the forehead each having a strong tooth. The legs are short, and the honey-tubes long.

The larva (or louse as it is commonly called in its earliest stage) is very pale; later on, in the pupa state, the head and fore part of the body are broad and squarish and the colour green.

The wingless viviparous female is pale green, with from one to three green stripes down the back (see figure for general

* The above figures are acknowledged, with thanks, as reduced copies of figs. 1 and 4, Plate xxx., vol. 1 of 'Mon. of British Aphides,' by G. B. Buckton, F.R.S.

appearance). The winged viviparous female is also pale green, but has dark markings. The head, and band across body behind the head (*pro-thorax*), dark brown; and lobes on the thorax, one or more stripes across the abdomen, and four spots on each side, black; legs with brown joints to the thighs and shanks, and the horns with brown tips.

The winged male is a smaller and lighter made insect than the winged female, pale green excepting lobes on the fore body and shield behind it, which are olive; the horns and wings very long.

According to the common rule of life in the *Aphidinæ*, the appearance of the male in the later part of the summer, or in the autumn, precedes by a few days that of the *egg-laying* wingless female, and concludes the generations of the year. It is only between these that pairing takes place, and the fecundated female subsequently lays the eggs which give rise to the countless winged swarms of the following year, all produced without the further intervention of the male, until the season again closes with the autumn appearance of the winged male and wingless oviparous female. — ('Mon. of Brit. Aphides,' &c.)

The young, or larvæ, are commonly known as "lice" or "nits." These may be seen whilst being produced alive at the middle of May, and by careful search as early as the beginning of April. They are at first of a semi-transparent greenish white, afterwards they are green, and much resemble their parents, excepting in not having wings.

The viviparous females appear in greater or less numbers in the Hop-gardens towards the end of May or beginning of June. If the conditions are favourable, they then deposit their first brood of larvæ on the leaves of the plants, and, from the early date at which these young have the power of producing descendants, increase goes on at a rate which words do not convey, but which the state of the attacked plants shows only too plainly.

The result of this is, if the Aphides are undisturbed, what is known in Hop districts as "*a blight*" occurs. The powers of the leaves are exhausted by the millions of insects drawing out the juice with their suckers, and the pores of the leaves are choked by the fluid voided by the Aphides (or "honey-dew,") so that they cannot perform their natural functions, and the growth of the plants is consequently checked.

It does not seem now to be open to doubt that a great part of the yearly attack of Hop Aphis, or "Fly," comes on the wing from Sloe, Damson, or plants of the Plum tribe. This was long ago stated by German entomologists, also laid down by at least some of our Hop-growers, and in 1884, after care-

ful examination of specimens of Aphides both from Hop and Plum, and reports from Hop-growers (noted at length with figures in my Report for that year), I mentioned that there appeared to me to be reason to believe that the great attack, which usually occurs in the form of "Fly" about the end of May, *comes on the wing from Damson and Sloe*, as well as (which at this present date of writing I still think is to some extent the case) from Hop.

In 1887, Prof. Riley set the matter of migration from Plum to Hop beyond doubt by his observations of which a part was read before our own British Association;* he mentioned "*Phorodon humuli* hybernates in the winter egg state, this egg being fastened to the twigs (generally the previous year's growth) of different varieties and species of *Prunus*, both wild and cultivated." From the winter egg Prof. Riley found the female, the mother of the coming tribe to be hatched, the winged descendants of which female take flight to the Plum.

The existence of many generations on the Hop during summer we are all well acquainted with, but during Prof. Riley's stay in Europe, and more especially in England, he personally observed the point not previously worked out, of the autumn migration of the Hop Aphis back from Hop to Plum in the close of autumn.

On September 15th Prof. Riley wrote me from Maidstone,— "As I anticipated, I have found *Phorodon humuli* just migrating from Hop to Prune, and first wingless generation on Prune, but no eggs yet."

On September 24th also, writing from the neighbourhood of Maidstone, Prof. Riley noted, "*Phorodon* swarming on Plum-trees here."

On October 1st Prof. Riley wrote me that he had now brought the *Phorodon* investigations to a successful close, and completed the whole life-cycle. "Last week pairing was everywhere going on, and on Saturday I noticed the first eggs. The Plum-trees are now being rapidly stocked. The male is winged and the female wingless, as I had surmised, and the first generation on the Plum is the sexed one."

Further, Prof. Riley informed me that the Aphis eggs (which he had seen on the Plum-shoots) became black. This agrees with information, sent me by various correspondents during the last few years, that they had noticed black eggs, of which they sent me specimens, from which they had no doubt they had hatched Hop Aphis.

These observations, coming from such a high authority as Prof. Riley, give thorough confirmation to the belief previously

* The paper was read before Section D of the British Association for the Advancement of Science, Manchester, Sept. 3rd, 1887.

held as to migration; but still I do not myself think that in this country *the whole of the attack* comes on the wing from Plum, Damson, or Sloe.

I think this because we have found Aphides (that is, wingless females and lice), on Hop as early as the end of March and the beginning of April, long before the attack coming on the wing made its appearance.

Just to give a few instances:—In 1884 Mr. C. Whitehead, writing to me from Barming, Maidstone, on the 29th of March, mentioned, "I have found the enclosed Hop-shoot, with the larvæ *in situ*, in my Hop-ground this morning. There was a wingless female, which had evidently deposited viviparously the larvæ enclosed." . . . "I dress late, and so I have plenty of shoots which will soon be cut off, and upon these I found the lice I sent to you. I went out in the afternoon and found lice upon many of the hills," . . . "where there were small lice, in most cases a wingless viviparous active female was not far off. I found them chiefly in a part sheltered from cold winds, and where hatching or awakening from hybernation would be early. I should say I found a hundred at least in ten minutes."

On the 31st of March (that is two days later) I had information from another locality in Kent, of some "lice" being found on "Grape" Hops. Early in April, Mr. Whitehead further wrote me that he had found more "lice" on Hop-shoots, and that two farmers had just called and brought more, and on the 12th of April Dr. T. A. Chapman, writing from Hereford, reported that after careful search in the Hop-yards where the bine was two feet high, he could find *no trace of "Fly,"* but on the following day he found a bine with seven or eight Aphides on it. These were wingless and nearly full-sized.

Also in the Stoke Edith experiments, made in 1884,* it was found that in the case of the Hop-hills which were dressed with applications to keep the Aphides from coming up from around the Hop-plant, the bines on these hills (more than twelve hundred in number) were free from attack until the fly came at the end of May, *although the rest of the Hop-yard was infested.*

We do not know the reason of this at present, but it may at least be conjectured that it is owing to hybernation of the Aphis pest in the Hop-hill.

Prevention and Remedies.—These various observations point to some benefit being obtained by dressing hills so as to

* For detailed observations on Hop Aphis see Appendix to my Report on Injurious Insects for 1883, and Report for 1884.

delay attack, and certainly to all measures which will prevent attack coming *from* Plum-trees being of service, including in these destruction of the great hedges of Sloe which are found in some places; and also (of course) "washings," as a well-known necessity when attack has come to the Hops.

Special experiments as to effects of dressings applied for the purpose of preventing Aphides coming up from the earth of the hills to attack the young Hop bines, during May, were tried by Mr. A. Ward on an acre of land in the Hop-grounds of Lady Emily Foley, at Stoke Edith Park, near Hereford, kindly lent by her for a trial-ground. At the beginning of May about twelve hundred plants were dressed respectively with paraffin oil mixed with shoddy, with ashes, with sawdust, and with ashes and sawdust, and the remainder with lime; with soot; with gas-lime; with gas-lime and soot; and likewise with salt and ashes, without addition of paraffin.

The salt, salt and lime, and likewise the gas-lime, were all more or less injurious to the plants; but the seven hundred plants dressed with paraffin oil in ashes, or in some material by means of which it could be spread on the hills, *did well throughout*, besides being (as above mentioned) free from attack till it appeared in winged form.

The proportion used was one quart of paraffin oil to one bushel of ashes, or of the other dry materials; the surface of the hill was well covered with the dressing, and where the shoots had been pulled off from two rows the stocks sent up strong shoots again through the paraffin applications.

In the first lines of the extract following it will be seen that Mr. C. Whitehead, so well known as a special authority on matters connected with Hop-growing, strongly recommends dressing Hop-hills as a preventive measure.

"One of the best modes of prevention in the case of Aphides is undoubtedly to put caustic substances, such as lime, soot, lime-ashes, and others, round the stocks, or plant-centres during the winter. Bines should be carefully collected and removed from the Hop-gardens before February. All dead pieces of bine should be cut away from the stocks and burnt or taken away. The outsides of the Hop-gardens should be kept brushed, and weed-growth prevented.*

In the same paragraph Mr. Whitehead drew attention to the advisableness of Damson-trees found to be infested with Aphides being "washed," to prevent the migration of the "Fly" to the Hops, and the observations of the last few years have shown still more clearly the great importance of thus destroying the enemy before it takes wing. In this it will be

* 'Report on Insects injurious to Hop,' prepared for the Agricultural Department, by Charles Whitehead, F.L.S., &c., 1885.

observed it is only the true Hop Aphis, the *Phorodon humuli* scientifically, the Aphis which migrates between Plum and Hop, that is spoken of, not the common Plum Aphis, which may be distinguished by *not* having the tubercles on the forehead, nor the gibbous base to the antennæ which characterise the Hop-*and*-Damson Aphis.

Washings.—"The best composition is 100 gallons of water, —soft water if possible, or, if hard, with soda added; 4 to 5 lbs. of soft soap, pure; 6 to 8 lbs. of quassia; boiled well to get full extract.

"This wash is sent up, squirted up and over the Hop-plants, the play of the jet being directed to the under surfaces of the leaves by means of large garden-engines with strong pumps and long flexible hose, and jets held under the leaves by men. Large planters employ washing-machines * drawn by horses between the rows, whose pumps are worked by the wheels, and force the wash up and over the plants through a series of tubes perforated at intervals.

"This washing process, in order to be perfectly successful, must be commenced directly there is any deposit of lice upon the leaves, and continued systematically until all of these have been cleared off. In some seasons fresh flies are continually wafted to the plants, and in this case it will be necessary to wash frequently and watch the plants with great care.

"The advantages of washing Hop-plants for Aphis blight were clearly shown in 1882. Planters who washed grew crops of from 7 to 9 cwt. per acre, while those who did not wash their plants grew nothing or next to nothing." †

The proportion of quassia used varies, presumably according to special circumstances or views of the Hop-grower. The following note was sent by one contributor, as to method of preparation:—"We steep the quassia in cold water, as it is said the properties are extracted better by cold than hot water, as the heat tends to expand the wood, thus preventing the water penetrating into the chips. But we find we get a very strong extract from chips which have been previously steeped in cold water by very rapidly steaming for a couple of hours."

The following recipe for Hop-wash, used by an extensive grower, has also been found serviceable in dry weather:—To thirty-six gallons of water in a copper add sixty pounds of soft soap. Then add either fourteen pounds of bitter aloes or two pounds of tobacco, and boil together. For use, add thirty-six gallons of water to every gallon of this liquid.—(J. W.)

* The horse washing-machines have recently been much improved.

† Report previously quoted.

In some cases a little soda is found serviceable, mixed with the solution of soft-soap.

An addition of some amount of paraffin to soft-soap wash has been shown to be of use by the experiments of Mr. Ward at Stoke Edith in 1883 and 1884. The proportions used by him for large quantities were 12 lbs. of soft-soap and half a gallon of paraffin to 100 gallons of hot water, the mixture stirred well together and used when cool; the nearer boiling that the water is used the better the paraffin mixes. (This wash is found to be very effective in killing the Aphides without injuring the plant or the burr, but it requires such great care in mixing, and also in use, lest the mineral oil should separate from the soft-soap wash, and also lest from state of weather or any other circumstance it should injure the leafage or burr, that I do not venture to *recommend* it as a *broadscale* remedy. — E. A. O.) For methods of permanently mixing soft-soap and mineral oil, see Index.

It is found that circumstances of locality, whether from soil or surroundings, exercise an influence in the amount of attack, as "In some districts the Hop-plants are more liable to be blighted than others, and in most districts there are 'lucky' farms upon which the Aphis blight or mould rarely affects the plants. A hedge or a stream frequently forms a line of demarcation between Hop-land that is liable to blight and that which ordinarily escapes blight."—(C. W.)

Weather influences have great effect on the Hop. Under favourable circumstances it grows rapidly, especially in warm nights — as much as four inches of growth having been recorded as taking place in one night on bines. East winds in the spring are unfavourable to the plants, and favourable to Green Fly. The sunshine and warmth in sheltered positions which often accompany these winds, alternate with frosts at night that check the growth of the tender succulent shoots, and thus a state of sap is produced peculiarly suitable to the Aphides, which increase rapidly under these circumstances.

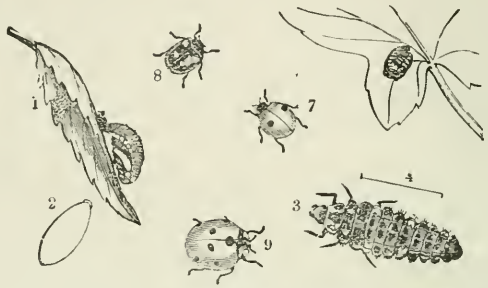
Practically it has been known as far back as Tusser's time, that—

> "The wind in the North, or else Northerly-East,
> Is bad for the Hop as a fray at a feast,"

and scientifically the recent observations of Mr. G. B. Buckton, as to the more rapid development of Aphides on plants of which the sap is sickly, and the amount of food to be drawn from them insufficient, points to the reason of the increased attack, but how this knowledge is to be utilised does not appear at present.

Amongst natural means of protection we have some help

from the Aphis-eating birds, but the chief assistance is from the *Coccinellidæ*, the beetles well known as "Ladybirds," which feed (especially in the larval stage) voraciously on the Aphides.



Ladybirds and chrysalids: 1—4, egg mag.; larva and chrysalis, mag., and with nat. length; 7, *Coccinella bipunctata;* 8, *C. dispar;* 9, *C. septempunctata.*

The above figure shows the appearance of the slaty-grey six-legged grubs (magnified, with line giving length when full-grown). These grubs are prettily marked with scarlet and yellow, and when full-fed, which is in about a fortnight or three weeks, they hang themselves up by the tail, and turn to a shiny black pupa or chrysalis, spotted down the back with orange, from which the beetle (known as the "Lady-bird") comes out in about another fortnight or three weeks. The figures give the common red Ladybird, distinguishable by its seven black spots, and also two smaller kinds.

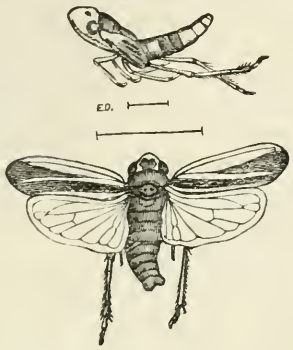
These should be by all means protected, and especially when they appear in the vast swarms in which they frequently follow on a special outbreak of Aphides, and in which to our great injury they are liable to be swept up and destroyed, as in the instance of their great appearance in 1869.

Hop Cuckoo Fly, Frog Fly, or Jumper.
Euacanthus interruptus, Linn.

Hop Cuckoo Fly is sometimes very troublesome in Hop-gardens. In the summer of 1881 it was very injurious to Hop-plants in various parts of Kent and Hants, and it was very troublesome again near Alton, Hants, in 1883. It was then reported (from near Alton) as having been observed in that neighbourhood, sometimes slightly, sometimes to a very serious extent, since 1876 inclusive.

The figures (p. 127) show the perfect insect (magnified), and also in its early stage, with its broad frog-like head (before the

wings are formed), in the act of taking one of its tremendous leaps, with its long legs flying out far behind.



Hop Frog Fly, and early stage of the same, mag., and lines showing nat. size.

The colour is yellow, variously marked, or banded with dark brown or black, and the upper wings, although differently marked in various specimens, have commonly a long triangular brown mark from the tip to the centre, and another brown marking running along the hinder edge. The abdomen of the female is furnished with a long fairly strong ovipositor. The young "Cuckoos" were first observed at the base of the plant, as tiny things no bigger than a Hop-louse. In another year they were also noted as being found first in the base of the plants close to the ground, amongst the superfluous bines which are neglected by the tyers and allowed to trail on the ground. The earliest date of appearance given was some time preceding the 20th of May.

They were found in young state on the Hops in the early summer, and judging from the specimens sent, both from Kent and Hants, all or the chief part of the "Cuckoos" had gone through their various stages, and developed to the perfect winged insect by the end of July, when their cast skins were to be found in great numbers beneath the Hop-leaves.

By examination of the female I found eggs apparently quite fully formed; these were cylindrical, long, narrow, bluntly pointed at each end and white, and were very few in number; I think not more than four or five.

At this date, that is when the insects were fully developed, the attack rapidly diminished, and no recurrence was reported, but as yet no observations have been attainable, nor have I been able to find any in such work as I have access to, as to where the eggs are laid.

Prevention and Remedies.—The damage caused by the "Cuckoos" in their various stages, is by reason of their

sucking away the juices of the plant, and thus both weakening it and injuring the healthiness of its condition by the harm caused in the operation to the tender tissues.

Mr. D. Turvill, of West Worldham, Alton, Hants, who observed this attack and reported on it to me for three successive years, forwarded me, in July, in 1881, the following note as to the appearance of the attacked Hops, and the method found most serviceable in getting rid of the insects:—

"They principally infest the tops, and therefore most succulent portions, of the bines: when once a plant becomes a prey to them it is visibly checked in growth, the leaves assume a deformed shape and curl at the edges, and it rarely gets over (in the same season at least) the persistent attack of these little pests." "This season the ravages they are committing are very serious, many gardens being all but ruined."

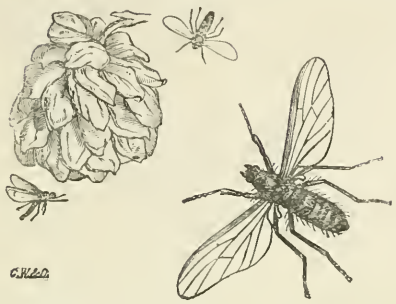
Mr. Turvill notes the most serviceable remedy tried near Alton has been the use of gas-tar. He mentions a very extensive planter had two trays (about six feet by two feet six inches) made expressly of corrugated iron, turned up with a three-inch rim, and with a handle at each end. These were smeared with tar, placed one on either side of the hill, and (the poles being shaken) were found to collect the insects most effectually, contact with the tar being immediate death to them. The same principle was employed in other ways, as by a strip of bagging or cloth tarred, &c., and found in every case of great efficacy.

If (as appears likely, from the young "Cuckoos" being first seen on the shoots near or lying on the ground) they hatch out of eggs amongst the shoots, or in the ground beneath the surface of the hill, dressings such as have been found useful for preventing young Hop Aphides coming up (see p. 123), could not fail to be useful, or (generally) any dressing or disturbance of the soil near the Hop which would not hurt the plants, and would disturb or throw out the egg or young "Cuckoo."

Till we know certainly where the egg is laid, we cannot be sure what measures will forestall attack; but the following note, also sent me from East Worldham, near Alton, Hants, points to liability of transportation:—

"A grower had a plantation infested by 'Cuckoos'; it was grubbed and the poles removed during the winter to another ground, which up to this time was free. It is now as badly troubled as the old garden."—(G. T.)

Fever Fly.* *Dilophus vulgaris*, Meigen; *D. febrilis*, Linn.



Dilophus vulgaris: Female Fly magnified and nat. size, flying round Hop-cones.

This Fly sometimes appears in vast swarms, and in the most various kinds of places. It appeared amongst the Hop-cones at Rainham, in Kent, in 1882; it has been observed in enormous numbers off the Norfolk coast: in 1862 it was recorded as hanging in millions on flowers and in bunches on grasses.

At the beginning of April, in 1884, specimens of larvæ were forwarded to me from near Sittingbourne, with the information that they were found in a piece of Hop-root sent accompanying, and appeared to be feeding on it, and that the same kind of grubs were then rather numerous in the Hop-hills. The piece of Hop was partly decayed, and, on cleaning it to gain a sight of the state of surface, it appeared freshly injured, as if the grubs were feeding *on it*,—that is, on the live part, not merely on the decayed matter outside.

A few days later it was reported from Sharsted that, "These grubs appear to be doing much damage to the Hop-plants by gnawing away the original plant, and considerable quantities of them may be found even at one stem."

These little grubs were only about a quarter of an inch in length and like small Daddy Longlegs grubs in shape—that is, cylindrical and legless—but more prickly, and with the head brown or chestnut-coloured; and about three weeks later a further supply was sent, of which some were then gone on to the chrysalis stage—whitish, and which (like the Tipulide or Daddy Longlegs chrysalids) showed the shape of the insect forming within.

The flies began to develop about the middle of May, and

* As this Fly appears to be without an English name, I have retained the original one given by Linnæus from the Fly being supposed to occur in the rooms of fever patients.

proved (when submitted for examination to Mr. R. H. Meade) to be the *Dilophus vulgaris*, Meigen, a small two-winged fly (for size and shape see figure, p. 129), of which the males are intensely black; the females have the abdomen brown, and the wings brown or blackish. A second brood appears in autumn.

The amount of damage that it may cause is worth watching, for, as far as we see at present, it is one of the instances in which the grubs are double-feeders. They are considered to *live upon the roots of plants*, particularly of Grass and Corn. John Curtis, in his 'Farm Insects,' p. 467, notices this same species of *Dilophus*, then known as *febrilis*, Linn., as "exceedingly abundant every year, and the larvæ causing much damage in the gardens"; but also the grubs are to be found both in horse and cow manure, and were noted by Curtis as found in considerable quantity in "a vine border amongst the horse muck."—('Gard. Chron.' 1844.)

Looking at these various points together, it seems very likely that the flies lay their eggs in the manure, and thus the grubs are introduced to the roots of the plants; and if, on further investigation, the damage done to the roots prove important, it is this point (the presence of the grub in manure) which will be the one to look to first.

Hop Flea.

Haltica concinna, Curtis ('Farm In.') = *Chætocnema concinna*, Marsh.

1 and 2, Hop Flea, nat. size and magnified; 3, hind leg, magnified.

This species of Hop Flea, known as the Brassy or Tooth-legged Turnip Flea, is very like the common Turnip Flea or Fly-beetle, but differs in being more oval, convex, and shiny. It is of a greenish black colour, with a brassy or coppery tint; the horns are only half as long as the body, and of a pitchy colour, more rust-coloured towards the head; the wing-cases have ten lines of deep dots along each; the legs are black,

but bright rust-colour at the base of the shanks, and the shanks on the second and hind pairs of legs are short, acute, toothed below the middle, whence the common name of "tooth-legged" and the scientific synonym of *dentipes*. This flea-beetle infests Hop-grounds and Turnip-fields, and is also to be found in hedges, Nettles, and Grass.—('Farm Insects.')

It does not appear certain, however, that it is the *only* kind of flea-beetle that infests our Hop-grounds, and the following observations on the habits of the "Hop Fleas" are given with the note that, although certainly the species described above by Curtis as *Haltica concinna* infests Hops, yet it is not a kind especially confined to the Hop:—

"These flea-beetles hybernate in the perfect state in the ground close to the Hop-hills, or in the hollow dead bines left on the stocks, or in the pieces lying on the ground near them. They emerge in the early spring, and attack the shoots of the Hop-plant, piercing them as soon as they appear.

"If the weather is cold, and the shoots unable to grow away rapidly, the Flea occasionally causes serious injuries, and makes them stunted. They are especially active in dry seasons and when the land is rough. In wet seasons and in growing seasons, when the shoots go quickly up the poles, they do not cause much harm in the early stages of the plant-growth. But later on in the summer, after a very dry season which has been favourable to their increase, they get into the cones and deposit their eggs. From these eggs the larvæ—little white maggots with six pectoral feet—are hatched in about ten days; they immediately begin to burrow in, and feed on the stalks or 'strigs,' causing their decay, and making the bracts of the cones lose colour and become disintegrated.

"During the spring and earlier part of summer the eggs are laid in the bine, or under the skin of the leaves."—(C. W.)

Prevention and Remedies.—"To check the Fleas, planters dust lime or soot over and around the Hop-hills when the shoots are low, but there is no remedy adopted against their onslaughts after the bines have been tied to the poles.

"One means of preventing the spread of these beetles is to have all the pieces of old bines carefully removed from the Hop-garden after Hop-picking and all the cuttings after the hills have been 'dressed,' and to move and pulverise the ground as early as possible in the spring. The Flea is very injurious to the bine in early spring, particularly in dry weather, and where the land is rough and badly cultivated."—(C. W.)

The following remedies have been suggested, namely, to

cover up the young shoots with four to five inches of fine mould, which gives them security from being injured by the Flea for several days, when the bines will have acquired more strength and grow more rapidly away from attack; and where much injury is done, the application of a little rich manure, as Peruvian guano, is recommended. — ('Farm Crops,' by Prof. J. Wilson.)

In the 'Report on the Flea-beetle of the Vineyards of the United States of America,' where great losses are caused by the species *Graptodera* (*Haltica*) *chalybea*, Illiger, besides the above mentioned measures of clearing all pieces of old bine, broken wood, and rubbish, under which the beetle can harbour in winter, it is stated that when attack has commenced, good may be done "by syringing the vines with a solution of whale-oil (= fish-oil, Ed.), soft-soap, two pounds of soap to sixteen gallons of water."

The following method, which was found to keep the flea-beetles in check in a large vineyard at Arlington, Virginia, might be serviceable:—

"A strip of cotton-cloth three feet by six, kept open by cross-sticks at the end, is thoroughly saturated with kerosene and held under the vine, which is shaken by the supports being struck. The beetles fall readily by the jar, and contact with the kerosene sooner or later destroys them. . . . . After striking the sheet the flea-beetles show no disposition either to fly or jump."—(Report of the Commissioner, Department of Ag., U.S.A., 1879.)

It is stated that, with these sheets, three boys rapidly clear the vines over a large space of ground, and in case of bad attack the method would be worth a trial in our Hop-grounds. *

Otter Moth. *Hepialus humuli*, Linn.

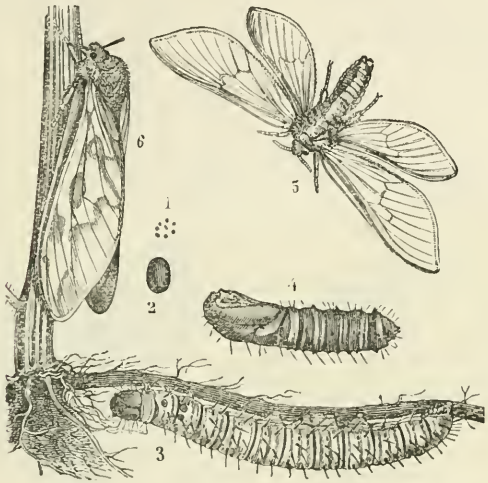
The caterpillars of this moth (which is known also as the Ghost Moth, or Ghost Swift) injure the Hop by infesting the roots, "which they penetrate with their strong jaws, consuming the inside as well as the bark."

The moths fly in the evening, after lying concealed during the day amongst leaves or grass, and it is stated that during this flight the females drop their eggs one by one.

The caterpillars are of a cream-colour, with brown heads, and a scaly patch on the next segment. They bury themselves in the ground, and feed below the surface until they

* For measures of prevention and remedy, turning on cultivation and condition of ground, and state of surroundings, &c., see paper on "Turnip Flea-beetle."

are nearly an inch and a half or two inches long. When full-fed they spin a web amongst the roots on which they have been feeding, and in it they turn to stout, blunt, dark brown pupæ with two rows of spines.



Otter Moth: 1 and 2, eggs, nat. size and magnified; 3, caterpillar; 4, chrysalis; 5, male; 6, female.

This change takes place in May, and the moths are common in grassy places about the middle of June, especially in the south of England.

They are very peculiar in appearance, from the wings being somewhat straight and narrow; also there is not any great difference in size between the front and the hinder pair.

The male is about two inches in expanse of the wings, which are white above; the head, body, and abdomen are pale tawny. The female is about three inches in expanse; the fore wings are yellow above, with orange markings; the hinder wings smoky, changing to bright tawny on the hinder margin.

Prevention and Remedies.—The injuries occasioned by the larvæ of the Ghost or Otter Moth are recorded as being sometimes to a serious extent in foreign Hop-growing, but appear to be less prevalent here.

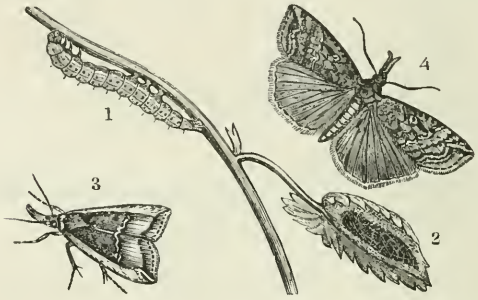
As the caterpillars feed amongst roots, the best remedy is to examine these carefully, if the plants are found to be flagging without obvious cause. From the large size of the caterpillars they are easily seen, and can be taken out by hand and destroyed; and if there is reason to suppose they are present,

it is well to have a stock here and there examined throughout the ground when the plants are dressed in the spring.

Also, as the moths frequent grassy places, and the caterpillars feed on the roots of the Burdock and of the common Nettle, it would be very desirable to clear off these large weeds and also patches of neglected Grass which give harbourage by day to the moths.

Hop-vine Snout Moth.

Pyralis rostralis, Linn.; *Hypena rostralis*, Stephens.



1, caterpillar; 2, chrysalis; 3 and 4, moth.

The caterpillars of this moth injure the Hop by feeding on the leaves. They are of a pale green colour, with clearer spots, and a whitish line on the sides and back; slender in shape and gradually smaller towards the head, and of the size figured above; and are distinguishable by having only three pairs of sucker-feet (in addition to the true feet on the rings next the head), and the pair of sucker-feet at the end of the tail.

When full-fed the caterpillar draws a leaf partly together, and commonly changes to the chrysalis in a light cocoon which it spins within the folds.

The moth, which appears in June and July, or earlier, is rather more than an inch in the spread of the wings, and is variable in colouring. In well-marked specimens the fore wings are greyish brown, darker from the base to about the middle, with a zigzag blackish streak across near the tip, and some raised tufts of black scales about the centre; the hinder part of the wings is palest. The hinder wings are brownish.

The moths of this genus may be generally known by the snout-like appearance of the front of the head, whence they take their name.—('Illus. Brit. Entom.')

Prevention and Remedies.—Strong syringing, by means of the engines, with some of the regular Hop-washes, or with the common fish-oil soft-soap procurable at ten to twelve shillings per firkin of sixty pounds, appears to be one of the best remedies known. The soft-soap makes the Hop-bines unpleasant to the caterpillars, and, if applied as soon as any large number of the moths were seen about early in the season, would probably deter a large proportion from laying eggs on the syringed plants.

Jarring the poles is also recommended, so as to make the caterpillars (which loose hold on a slight shake) fall to the ground; but the difficulty in this method of treatment is to keep them from going back again up the plants. Trampling on them, throwing soot, lime, &c., or, in bad cases of attack, shaking them into something placed below or on to tarred boards, are recommended.

Hand-picking the leaves with the moth-cocoons inside gets rid of much of the second brood, and these cocoons are also to be found about the stems of their various food-plants, on the surface of the ground, or in sheltered nooks. Clearing away plant-rubbish generally, and more especially the Nettle on which this caterpillar feeds, would be of service.

Red Spider. *Tetranychus telarius*, Linn.

"Red Spider," and hairs on the foot (from Claparede), magnified. (Nat. size ordinarily invisible to the naked eye.)

The "Red Spider," which causes enormous damage in dry seasons to the Hop-crops, is neither an insect nor (properly speaking) a spider. Strictly speaking, it belongs to the "Spinning Mites," * and the figure gives a greatly-magnified view of the long stiff hairs on the feet with globular formations at the tip, which are of use in spreading their webs.

The egg is oval, or spherical, and colourless, and may be

* Fam. *Trombidiinæ*, Order *Acarina* of the Class *Arachnida*.

found amongst the webs on the leaves. The larva (as it is called, although the name is hardly appropriate, the "Red Spider" not being an insect) hatches from the egg in about eight days, and is much like the parent, excepting in having only three pairs of legs; it acquires the fourth pair with the change of skin (according to M. Dugès, at maturity).

When mature the "Red Spider" is oval, furnished with four pairs of legs, two pointing backwards and two forwards; the head, body, and abdomen form a solid mass, by which it is distinguishable from true spiders, which have the abdomen joined to the rest of the body by a fine stalk; and also from insects, which have the head, fore body (thorax), and abdomen commonly distinct from each other, and which also, in their perfect state, have never more than three pairs of legs. The head is furnished with a beak or sucker and nipping feeler-jaws, by means of which it draws the juices from the leaves and injures the surface, and beneath the abdomen, near the end of the tail, is a conical protuberance, from which the threads are produced with which it forms its webs.

The colour is various; of transparent yellowish white, orange, reddish, or brick-red, and other tints, depending, as far as present observations show, on the colour and nature of the food within, and partly also on the age of the individual.

The "Red Spider" has difficulty in moving on perfectly smooth surfaces, but, by means of its claws and the pin-headed bristles with which they are furnished, it moves readily on the under side of the leaves, and fastens its threads to the hairs or slight prominences, thus gradually forming a coating of web, amongst which it lays its eggs, fastening them by some glutinous secretion to the threads, and under this shelter a colony, consisting of many of both sexes in maturity, and young in all their ages, feed and multiply with rapidity.

The attacked leaves may be known by their greyish or yellowish, somewhat marbled, appearance above, whilst beneath they are whitish and shiny from the covering of web. This kind of Red Spider has been found sheltered, as if for the winter, beneath stones.*

Prevention and Remedies.—"This little mite, hardly to be distinguished without the aid of a glass, works much mischief in very hot dry seasons. Its effect upon the leaves of the Hop-plant was until a few years ago attributed to heat and drought, and was called 'Fire-blast.' In the unusually hot and dry summer of 1868 the 'Red Spider' did immense

* The above information is mainly taken from a paper by John Curtis in the 'Gardeners' Chronicle,' vol. for 1841, and information in 'Economic Entomology,' "Aptera" by Andrew Murray, pp. 88, 89.

damage in the English and German Hop-plantations. The leaves of the plants turned brown, became shrivelled, and fell off; and thousands of acres produced no Hops."—(C. Whitehead.)

The following note describes the progress of the attack, and the effect of rain in checking it; and also gives some idea of the amount of loss consequent on attack:—

"Red Spider in Hops.—This only appears in dry seasons. It shows itself first by a brownish yellow appearance in the middle of the leaf, generally at the top of the poles, in large spots, spreading rapidly all over the Hop-garden, unless rain comes, which, if of any continuance, stops its progress. On looking under the discoloured leaves a small web will be found over the whole surface. After a time these leaves drop off, and the Hops all become red or brown.

"In 1868 I had fifteen hundredweight per acre reduced on several acres to five hundredweight, and then the five hundredweight were only worth about half-price. We do not use anything to stop it, because of the Hop being out."

"Red Spider" does not spread in late Hops which have been kept back by vermin, as the leaves are young and full of sap. It is dryness in everything that conduces to its spread, and I should think that this year one thousand acres of Hops have been left unpicked through it.—(J. W.)

Besides the winter shelter found by the Red Spider under stones near where infested leaves have fallen (mentioned by M. Dugès in Murray's 'Aptera' previously quoted), it is mentioned by Mr. C. Whitehead that "in the case of Hop-plantations they also retire into the cracks of the poles, and they have been found upon the Hop-bines after they have been stacked for litter, as well as upon the ends of bines left in the hills or stocks during the winter."

To this I add the following observations, extracted *verbatim* from Mr. Whitehead's special Report on Insects Injurious to Hop-plants, Mr. Whitehead being a well-known and approved authority on the subject of Hop-growing in its various branches:—

"As English Hop-planters cannot irrigate the Hop-land, as is done in Tasmania, the only means of prevention are to apply hot lime or other caustic and pungent substances, as soot or lime, round the Hop-stocks in the late autumn after an attack, taking care that this should be put over the stocks and pieces of bine left on them. After an attack it would be of course desirable that the poles should be treated with a solution of paraffin or petroleum to kill the mites in their cracks. Practically, however, as Hop-planters would agree, this is almost impossible. In the case of poles that are fixtures

in the ground to carry wires or strings, according to the new methods of training Hops, so much adopted in Germany and extending in this country, it would be well, after an attack of Red Spiders, to wash these poles with a strong solution of soft-soap and water, with quassia added, or with paraffin or petroleum solutions brushed well into the crevices. Poles should be well shaved before they are set up, as their bark harbours these mites and many insects injurious to Hop-plants.

"Kaltenbach, the German entomologist, says that washing with water containing solutions of sulphur and tobacco may be advantageously employed. This was tried in 1868 in England without much benefit. The only effectual remedy would appear to be washing the plants by means of hand or horse-engines, with a composition of water, soft-soap and quassia, in the following proportions:—100 gallons of water, 4 to 6 lbs. of soft-soap, 4 to 6 lbs. of quassia (extract after well boiling).

"Water alone would be effectual, only it runs off the web-covered leaves. The soap fixes it on them, and the bitter of the quassia makes them unpleasant to the tastes of the Red Spiders."*

Hop-growing being a very special industry I have not intermixed notes of treatment of "Red Spider" attack on other crops with the above observations, but, in order to place the observations on this infestation together, append some notes of treatment on orchard-trees or in gardens, which were given in the first edition of my 'Manual,' under the heading of attacks to Plum-trees, and have likewise appended an account of a severe case of infestation to Limes at Walthamstow in 1880.

Prevention and remedy of Red Spider attack on Plum or orchard-trees or in gardens:—

The "Red Spider" is most injurious to vegetation in hot dry weather; and consequently washings and syringings, or drenchings by means of the garden-engine, which will render the leafage and ground, and the walls to which the trees may be attached, moist, will be very serviceable. The extreme dryness of air and soil are thus counteracted, and a healthy growth encouraged, which more or less counterbalances the injury to the leaves from the suction of the mites.

It is important to check the attack at the very beginning, and for this purpose syringings morning and evening are advised, sent hard at the under side of the leaves, so as to

* 'Report on Insects Injurious to Hop-plants,' prepared for the Agricultural Department, by Charles Whitehead, F.L.S., &c., p. 30, 31.

break the webs and wash them down with the contained mites, if possible, or more probably do good by lodging something in them offensive to the mites.

Sulphur "is the active principle and most efficient agent" in preparations for destroying Red Spider, and sulphur and soft-soap combined in various ways are amongst the most reliable remedies.

Amongst the Hop-gardens in Kent "washing the plants with soft-soap and water, or even with pure water, is a remedy for the Red Spider, and some planters tried a solution of sulphur, thrown over the plants by the ordinary washing-engines in 1868, which killed these mites."

Looking at this point of sulphur being generally an ingredient in washes or applications for the destruction of Red Spider and other Acari, and the circumstance that in its crude state it does *not* combine with most of the fluids used for this purpose, may account for frequent failures in home-made applications. In order to make it combine with whatever liquid may be used, the sulphur should be boiled with an alkali, and the following recipe has been recommended: one pound of flour of sulphur and two pounds of fresh lime boiled together in four gallons of water; or, to save the trouble of boiling, the sulphuret of lime may be purchased and used thus:—Of this sulphuret take four ounces; soft-soap, two ounces to each gallon of hot water; the soap and sulphuret to be well mixed before the addition of the water, which is to be gradually poured on, the mixture being stirred during the time, when a uniform fluid will be obtained without sediment, which may be used when cool enough to bear the hand, and has been found to destroy insect-pests effectually and quickly. This may be used as a syringing, or a dip for infested shoots, or well-rubbed with a brush into infested bark.

"Gishurst compound, Veitch's Chelsea blight composition, Frettingham's liquid compound, are all good. Sulphur in any form seems potent."

The following recipe for dressing fruit-walls answers well as a preventive of attack:—Having obtained some soot-water, tolerably clarified and as strong a solution as can be procured, this is worked up with clay till the whole is of the consistency of thick paint, and can be applied by a common painter's brush; to this, flour of sulphur and soft-soap are added in such proportion as may be preferred: one pound of sulphur and two ounces of soft-soap to the gallon has been found to answer. Every part of the wall is then painted with the mixture, care being taken to get it well behind the shoots, and also to paint a broad thick band along the bottom of the wall. This application, made once in the season as a regular yearly

treatment, has been found to prevent Red Spider attack quite satisfactorily.—('Gard. Chron.,' 1845.) This plan acts by poisoning and burying the "Red Spider" in the walls, and also by putting a band in the way of such as have been wintering under stones and rubbish, so that they will not care to cross to get at the tree; other mixtures, as preferred by the cultivator, might be similarly used.

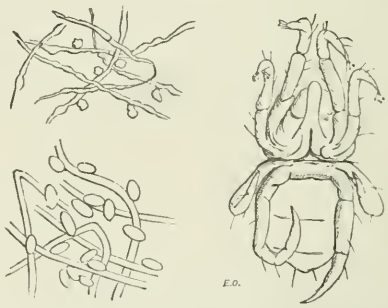
Clean and properly-pointed walls are a preventive of attack, as is also ground so cultivated and attended to that there shall be no neglected surface the mites can lurk in, or hiding-places under stones, clods of earth, or rubbish beneath which they can hybernate. An autumn dressing of gas-lime would be a desirable application to neglected borders where there are infested wall-fruit trees.

If by means of experiment it should be found that there is any fluid capable of dissolving the Red Spider's webs without at the same time injuring the leafage, we could thus, by clearing off its breeding-grounds, probably get rid almost entirely of the pest.

Hop and Lime-tree Red Spider.

Tetranychus tiliarum, Müll.; *T. telarius*, Claparede.

This attack is just mentioned, as an outburst of a special pest of this kind in special states of weather is of practical interest.



Red Spider of Lime-trees: web with eggs in dried state, and after being moistened, all greatly magnified.

Opinions differ as to whether the "Red Spider" of the Lime-tree is the common "Red Spider," *T. telarius*, or a distinct species, *T. tiliarum* (so named, from infesting the Lime), but which is also at times injurious to French Beans and some other garden-crops.

These Acari or mites, which are figured above were exceedingly injurious in the autumn of 1880, to some Lime-trees at Walthamstow, from which specimens were sent me.

From their extreme minuteness and transparency, the various parts show very indistinctly when magnified, and the nipping-jaws and sucker were not clearly visible. I have therefore only been able to give the general figure of the mite, with the peculiar long stiff hairs with knobs at the ends (which are believed to help the Red Spiders in spinning) figured on those feet, on which they were distinguishable.

These mites spin their webs over the trunks and branches, and beneath the leaves of the infested trees, giving a kind of glaze or silky lustre to the surface; and on this web they can travel easily. They are to be found heaped like masses of living yellow dust at the foot of the tree, and those on the leaves congregate chiefly on the lower side, sometimes so thickly that none of the green colour of the leaf is visible. Here they draw away the juices with their suckers, and, though they are but small, there are so many of them that the leaves shrink and die from the injury.

Prevention and Remedies.—The eggs, figured from life at p. 140, may be found attached to the webs; and it has been found that brushing the tree-stems hard and thoroughly, so as to remove the webs, is serviceable in some degree in clearing attack, and would be still more so if some soft-soap was brushed in at the same time.

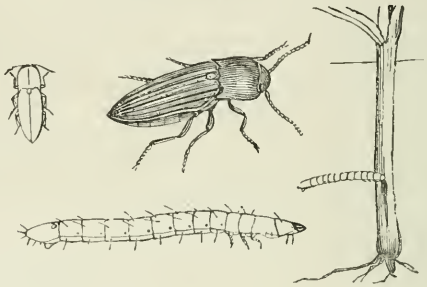
With regard to the masses that congregate together at the base of the tree, something might be done by banking round at a few feet distance and a few inches high, and filling the space enclosed with mud made as thin as would be retained by the raised edge. The Red Spider particularly dislikes moisture, and a few experiments would show what chemicals or other additions might be mixed with the mud, to poison as well as drown the pest.

A liberal mixture of fish-oil soft-soap, so as to completely plaster round the foot of the tree and stick all wandering mites fast that touched it, could not fail to do good at a trifling cost; but, excepting by such continuous and thorough drenchings as it is scarcely possible to apply to large trees, it is most difficult to do anything for the infested leaves.

The following recipe, however, might be of service:—Gas-water, three gallons, to which is added one pound of flour of sulphur; these to be held over the fire whilst being mixed, and soft-soap added in such quantity as to make the mixture adhere. This may be applied to the branches by means of a painter's brush, and where remedies are needed on a large scale it may be diluted to the state in which it is a safe application, and the liquid thrown over the leaves by means of the garden-engine. Probably fifteen parts of water to one of the mixture would be quite safe, but this would require trial.

This attack has been considered to follow peculiar atmospheric conditions, and its severe occurrence at Walthamstow above noted was after heat and drought, which is generally favourable to Red Spider.

Hop Wireworm. Larva of Striped Click-beetle.
Agriotes lineatus, Linn.



Striped Click-beetle and larva (Wireworm), nat. size and magnified.

This species of Wireworm is the grub of the Striped Click-beetle, an exceedingly common kind, which is often to be found on grass, in hedges, cornfields, &c. It is stated by Bouché that the Wireworm of this kind (the *A. lineatus*) is sometimes to be found in great multitudes in dung, and in vegetable earth.

For life-history of "Wireworms," see this head amongst Corn-insects.

Prevention and Remedies.—Wireworms are frequently very injurious to fresh-planted Hop-sets, especially upon recently broken-up pasture-land, eating off the tiny shoots directly they appear, and sucking the juices from the hearts of the sets. It sometimes happens that a large percentage of the sets die in consequence, and have to be replaced, involving great expense to the planter, as well as the loss of a year. The best and most sure way of getting rid of the Wireworm when at work on the Hop-plants is stated by Mr. Whitehead to be to put small pieces of Mangolds, Potatoes, Carrots, or Swede Turnips, or small pieces of Rape-cake two or three inches below the ground, close round the Hop-hills. These should be looked at twice-a-week, and the Wireworms which have eaten their way into them should be taken out and destroyed. As many as one hundred and fifty Wireworms have thus been trapped close to one Hop-hill.—(C. W.)

As these Wireworms, if once in possession, will live on in the same ground for several years (it is said five years), eating

the whole time, excepting when they may go down deep in cold weather, it is a very important matter to save the expense of trapping or attack, by taking measures that the ground should be (as far as is possible) clear of them before planting, and also that they should not be brought in with vegetable-soil.

When pasture is to be broken up for Hops, it is of service to brush it early in autumn with chain or brush-harrows, and dress it with lime-compost; this is a great preventive of the beetles laying their eggs. Folding sheep so that the grass is eaten very close answers the same purpose.

In preparing the ground it is much better, as regards getting rid of the Wireworm, to trench with the spade two spits deep than to plough with the subsoil plough following. The weeds and Grass-roots, and the like, in which the Wireworm feeds are not as thoroughly got rid of, even by deep ploughing, as by being thoroughly put down below by the spade, and the Wireworm has consequently plenty of food to keep it thriving until the new crop is put in.

Paring and burning is serviceable as a means of getting rid of the Wireworm and its food together, but has its drawbacks agriculturally; and it should be borne in mind that the Wireworm will go down as much as twelve inches in cold weather, therefore it is well to pare and burn before cold has set in; also the parings should be collected and burnt at once, or the Wireworms will very speedily secure themselves again in the ground.

All possible care in removing the clods with Grass-roots, and clearing the ground of rubbish which would keep the Wireworm in food-plants till the Hops come, would answer. (See "Wireworms" in Corn.)

The fresh vegetable-soil from old hedgerows or similar places brought in to restore old Hop-grounds is particularly likely to bring in Wireworm. It would save after expense to have the fresh field-soil heaped with lime or gas-lime, and the surface of the heap turned from time to time, to destroy Grass and weeds, which would otherwise serve as well for food to the grubs here as in the field. Gas-lime would thoroughly destroy all it touched—insect or plant—at first, if fresh from the works, but the atmospheric action or mixing with the earth would rapidly change its chemical nature to the sulphate of lime or gypsum serviceable to the crops.

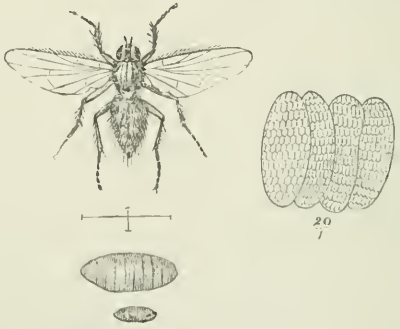
It is noted that in planting, "one good well-rooted set in good soil will make as good a stock as two or more; but it is safer to put two, for fear of Wireworm" (C. W.); and in the early spring season, when the Hop-plants are dressed and the hills covered with a little fine earth, it would probably answer well to add some insect-deterrent.

For Wireworm in Turnips, it has been found to succeed well to mix sand with just enough paraffin to moisten it slightly—not enough to clog, but still to run in the hand—and to sprinkle this *very* lightly over the roots by hand. Ashes or dry earth would answer as well as sand. It was found in the Stoke Edith experiments that the Hop-shoots came up without the slightest injury through a dressing of a bushel of dry material sprinkled with a quart of paraffin; and as the Wireworms usually feed near the surface, the smell, or the paraffin in dilute state driven down by the rain, would probably soon tell on them.

Mr. Whitehead mentions in his Report previously quoted that, "opening a trench in the autumn after the poles are down, and forming a ring close round the plant-centres, and putting in earth, ashes or sawdust, saturated with paraffin oil, is an excellent plan in the case of plantations that are badly infested" (*taking care not to put too much oil*, lest it should kill the roots). Likewise that "planters who suspect the presence of Wireworms very frequently set a row of Potatoes between the rows of Hop-plants, in order to draw the Wireworms from the young Hop-plants." And further, that "dressings of Rape-dust dug in round infested plants will also draw the Wireworms, relieving them for a time, but also tending to collect the Wireworms round or near the plant-centres."

MANGOLDS.

Mangold or **Beet Fly.** *Anthomyia* (*Chortophila*) *betæ*, Curtis.



A. betæ (female), mag.; line showing spread of wings, nat. size; pupa, nat. size and magnified. Eggs (after Farsky), mag.

The Beet Fly damages the crops by means of its maggots, which feed on the pulp of the Beet or Mangold leaves, and thus reduce the leaves, or large patches of them, to nothing but dry skin. This kind of attack does not appear to have been generally observed in the country till the year 1880, when the "Mangold maggot" was prevalent in many localities, and especially in Westmoreland and Cumberland, where, of 1624 acres of Mangolds grown in those counties, it is reported that all were infested. It had, however, been noticed in Cumberland several years before the above date; on which subject Mr. Watson Hornsby, of Abbey Town, Holme Cultram, Cumberland, favoured me with the following note:—"It would appear, however, that the insect has proved itself a pest to Mangold-growers in Cumberland several years previous to the one you name" (1880, Ed.). In 1876 the Mangolds on the farm I then occupied were much injured by it, but this was the first year that I had noticed the maggots in the leaves, although for some years previous to that the leaves of the young Mangold plants had presented, at certain stages of their growth, that shrivelled-up appearance which is a sure sign of the attack of the maggot; and I have no doubt that it was so, though at the time the injury was ascribed to other causes, frosts, &c. The attacks, however, were *not very severe or general until 1876*, since which the Mangolds have suffered heavily every summer, so much so, indeed, that in many districts they have been dropped out of cultivation in a great measure, only a few patches being grown in situations peculiarly adapted to their growth (August 26th, 1885).

The eggs of the Mangold Fly are very small, snow-white, and oval (see fig., p. 144, much magnified, by Farsky, showing honeycomb-like markings). These are laid in small patches beneath the leaves; as soon as the maggots are hatched they bore through the skin of the leaf, and, being voracious, clear away the substance rapidly. The maggots are about the third of an inch long, legless, cylindrical, blunt at the tail, and tapering to the head, which carries two black hooks by means of which it cuts away the pulp of the leaf. The colour is yellowish white, but sometimes green, especially towards the tail, from the intestines filled with green food showing through the thin skin. They feed for about a month, and then turn to chestnut-brown pupæ, sometimes in the leaves, but commonly they quit the leaves and pupate in the ground about three inches below the surface and near the attacked plant.

In summer the flies come out in about ten days or a fortnight. These are ashy grey, with various darker markings, and with black bristly hairs; and about half an inch across

in the spread of the wings. In the male the large brown eyes nearly meet on the top of the head, and the abdomen is very narrow, straight along each side, and with a black triangular spot down the centre, at the base of four of the segments. The female (figured p. 144, magnified) has the eyes distant, with a narrow white band round them on the face, and the abdomen is enlarged at the base, tapering to a blunt point at the tail, with three indistinct dark stripes along it.

The flies appear from March to May, and there are two broods (if circumstances are favourable there are probably more) in the summer and autumn. The date of development of the latest brood is variable; in regular course it passes the winter in the pupal state, but sometimes specimens develop at once, and hybernate.

Prevention and Remedies.—Mr. Watson Hornsby (in observations above quoted) mentioned further, "With reference to prevention and remedial measures, I should recommend *good cultivation, autumn if possible, a free use of fertilisers, and I consider a liberal application of salt, or potash-salt, or both, to to the land intended for Mangolds as a* sine quâ non *in Mangold growing.* Treatment of the foregoing kind will, I think, prove the best preventive. I have tried dusting of several kinds on the plant, but without perceiving any benefit; but a good drenching of paraffin and water I have known undoubted good results from. The difficulty is in applying the latter, as the mixture requires constant and quick stirring during application, or the paraffin will come off by itself."*

Mr. Jabez Turner (Norman Cross, Peterborough), wrote me that his plan was "to use a mixture of farmyard manure *applied in the autumn* as soon after harvest as possible, and a fair dressing of superphosphate, &c., put on with the seed." He further noted that he had never suffered from fly in a Mangold crop; and he thought if the plants were well fed and nourished, the growth was too strong for the enemy to do much damage. In 1884 Mr. Turner again observed:—"I am still in favour of *autumn manuring* for Mangold; in fact, on strong land I do not think the land should be worked in the spring, except with a horse-hoe. This will give sufficient tilth, and the condition of the manured soil will force the plant beyond the attack of the fly."

A rapid healthy growth, whether brought about by cultivation, manure, or weather influences, is, as far as appears at present, the only reliable way by which the maggot infestation when set up can be counteracted.

* For methods of uniting paraffin oil with soft-soap, see references in Index under these heads and "Emulsion."

In bad attack near Ormskirk in 1881, although the *A. betæ* eggs were observed in large numbers on the under side of the early leaves, favourable and moist weather enabled the plants to out-grow the plague; and in 1889 Prof. McCracken, writing from the Royal Agricultural College, Cirencester, mentioned, "The Mangold maggot was very prevalent in the first half of June, but the damage done, owing to the rapidity of growth at that time, was hardly appreciable."

Amongst special dressings, nitrate of soda, sowed between the rows just before showers, has been found to bring Mangolds, so completely wasted down by this maggot attack that the leafage was almost gone, well round, and saved a good crop of roots. In a case of attack reported from Cheshire, different parts of the field were dressed experimentally with guano, with soot, and with mineral superphosphate; and all had a good effect, but the superphosphate was the best.—(S. F.)

Any fertilising application which would push on growth rapidly and healthily, and thus help the plant to form new leafage more rapidly than it was destroyed by the maggot, would be sure to be of service.

Chemical manures would probably be better than application of liquid farm-manure, for many of this class of flies, if not sometimes farm-manure- as well as plant-feeders, at least would not be driven away by the application, and it would not lessen amount of next brood.

In some cases, where infestation has come on a crop when very young, it has been found to answer to send women on the land at once to hand-thin the plants, or nip out the infested piece of leaf. The infested plants being thoroughly got rid of, the five-acre field specially experimented upon did well.

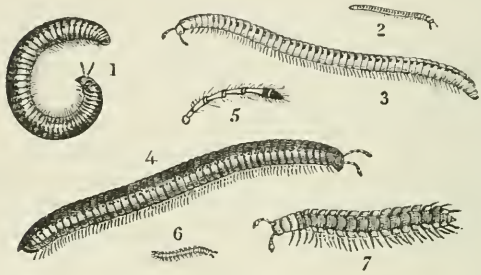
If the plants are carefully destroyed, the thinning-out plan may answer very well; if not, such a large proportion of the maggots will probably change to chrysalis without being hurt by the operation, that it will do little good.

This Mangold Fly attack appears to be just one of the infestations to which the application of fluid or powder-dressings by the strawsonizer would be likely to be of service as a means of prevention if taken in time, or of stimulating the plant-growth afterwards.

Snake Millepedes. *Julidæ* of various species.
Flattened Millepede. *Polydesmus complanatus*, Linn.

The *Julus* worms, or Snake Millepedes, are not true insects, as they do not go through three different stages of life, and

they never have wings; but from the great amount of damage they cause they may well be classed amongst crop injurers.



1, *Julus londinensis;* 3, *J. guttatus* (*pulchellus*, Leach); 4, *J. terrestris;* 5, horn; 7, *Polydesmus complanatus;* all magnified; and 2 and 6, nat. size.

The *Julus terrestris* (Linn.), figured above (magnified) at "4," is one of the largest of the British species. This is about an inch long, shining, cylindrical, of a dark lead or pitchy colour, with pale or ochreous legs, these amounting in number in the specimens examined by John Curtis to as many as 156. The segment immediately preceding the tail segment is furnished with a kind of spike ("mucronate").

Julus londinensis, Leach (fig. 1), is very similar to the foregoing, of a dark lead colour, but is distinguishable by the penultimate segment being just a little angulated in the centre *not mucronate*. The figure gives a good idea of how these black, shiny Millepedes are usually seen when disturbed from under a stone or rubbish, lying partly coiled-up with their multitude of short legs, forming a kind of fringe beneath the Millepede.

The *J. guttatus*, Fab. (*pulchellus*, Leach), figured nat. size and magnified at "2" and "3," is also cylindrical, and shining; it is of an ochreous colour, with a double row of bright crimson spots down each side excepting on the four first and five last segments. It has about 170 legs. After death the change of colour of this species to a red purple is very striking.*

The females are stated to lay their eggs in the ground from about the end of December until the following May, and to propagate most in undisturbed ground; but the Millepedes are to be found under rubbish, or amongst dead leaves, or especially in manure-heaps where much refuse garden rubbish is thrown.

* The above descriptions, and that following of *Polydesmus complanatus*, are mainly taken from Curtis's 'Farm Insects,' which see for full descriptions of various species, pp. 201—204.

The young Millepedes have, when first hatched, not more than three pairs of legs (*vide* Murray's 'Aptera,' p. 15); but with their successive moults they gain additional segments, and, as noted on p. 148, great addition to the numbers of their legs. They live for two years before arriving at full growth and power of reproduction.

The *Polydesmus complanatus*, or "Flattened Millepede," figured at "6" and "7" (p. 148), is distinguished from the Snake Millepedes by being flattened on the back, and the segments a little dilated at the sides. This is of a lilac colour above, whitish below and the back granulated; it is from about a quarter to over half an inch long, and has 60 legs. This kind is stated to be similar in its habits to the "Snake Millepedes," or *Julidæ*.

The attacks of the Millepedes appear either to have much increased or been much more observed of late years, and enquiries have been frequently sent me regarding injuries to field or garden root crops, and also of injury to Wheat. The Spotted Millepede, *J. guttatus*, often found in Strawberry fruit, is also excessively fond of Mangolds, therefore I have placed the attacks under the above heading. Besides preying on plants, "The Snake Millepedes are general feeders, consuming both decaying and living animal and vegetable substances. They prey upon slugs, small snails, insects and their larvæ and pupæ, earth-worms," &c.

Prevention and Remedies.—Very little has been communicated in the way of direct observation of means of prevention or remedy of Millepede infestation, but, looking at such information as is attainable, the following appear the chief points to be attended to:—

To avoid carrying Millepedes or their eggs on to the land whether of farm or garden in soil from infested manure or refuse-heaps. Millepedes are found under rubbish or amongst dead leaves, or in manure-heaps where much garden refuse is thrown; and where such manure is wheeled or carted to the farm or garden, infestation will be carried with it.

Where infestation is known to have been present in land, or is suspected to be present, it is desirable to disturb the surface well in the early part of the year, so as to throw out the eggs, and Millepedes of various ages; or trench in gardens, or plough with skim-coulter attached in the field, so as to bury down the whole infestation at once; or dress heavily with salt, nitrate of soda, or gas-lime.

In experiments tried by myself, and also by the bailiff to Mr. Pain, of Audsley's Wood, Basingstoke, Hants, in 1885, we found that a strong *solution* of common salt or of nitrate

of soda rapidly killed the Spotted Millepede; his report forwarded to me was as follows:—

"After receipt of your letter I went to the field when raining (pouring), and got about two pounds of the soil with the insects in, and added a tablespoonful of salt to one pound and the same quantity of nitrate of soda to the other pound: *in two hours' time the insects were still alive.* I afterwards added a *little water*, and they were all dead in both cases in five minutes' (just as Miss Ormerod said), but previous to my adding the water there was sufficient moisture in the soil to dissolve both the salt and nitrate of soda. Therefore, I think a *brine* of salt and water would be more effective, and put on with as little labour as dibbling the salt up the drills."

Cotton-cake has been found to attract them from the attacked crops, and the overwhelming fondness of the Pink-spotted Millepede (*J. guttatus*) for Mangolds may be turned to account, in attacks on special crops, by placing slices of Mangolds for traps, which I have seen swarming (when removed) with the Millepedes crawling over them in all directions.

An application of soot and water was tried in garden cultivation, mixed in the proportion of two handfuls of soot to one gallon of water. This was reported as successful; whether it acted by killing the Millepedes, or driving them away, was not mentioned. John Curtis mentions use of soot acting well in driving the pests away.

The following notes, also sent me from Audsley's Wood in 1885, are very serviceable, as giving an instance of the double feeding, that is on both animal and vegetable matter commonly attributed to the Millepedes:—

"We find them in bunches now and then round a bit *of bone or refuse* used in the manufacture of the manure; still they have a great liking for the Wurzel, as I have proved to-day. Upon searching I found the most of them deeper in the soil than I found them on Tuesday; I concluded this was owing to the rain, but I soon discovered it was in search of food.

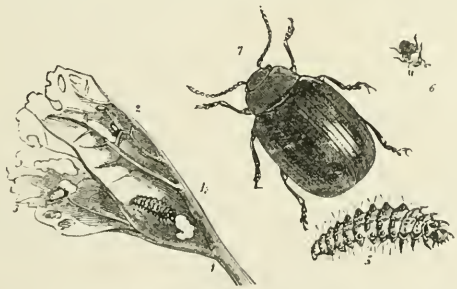
"Before drilling the seed I soaked half of it for forty-eight hours, and, when sufficiently dry, mixed it with the unsoaked seed, and drilled together. The soaked seed germinated in five or six days, and furnished food for these insects [Millepedes, Ed.] close to the surface; this they have devoured, and now they have attacked the unsoaked seed just germinating, as we find a bunch of from five to twenty round every seed. This accounts for their being deeper in the soil in this instance."

Power of migration.—In 1885, Mr. J. A. Smith, of Rise Hall, Akenham, sent me specimens agreeing with the Earth

Millepede, *J. terrestris*, with the note that a few mornings before he had noticed the Millepedes in great numbers crossing a road from a field of Oats towards a pasture-field. The Oats were after Turnips (both crops partially failures), and the manure had been of a mixed sort suitable for encouragement of the pests. This power of migration would account for the very sudden appearance of attack in full force—for as Millepedes live for two years before they are full-grown, it may be presumed when a sudden devastation is set on foot, that they have suddenly arrived—for there is *no sudden* change in their powers, and if present previously in the warm season, they could not fail to have been feeding up to the date of observation.*

MUSTARD.

Mustard Beetle ("**Black Jack**"). *Phædon betulæ*, Linn.



Phædon betulæ: 1, 3, 4, larva (natural size) on leaf; 5, larva (magnified); 6, beetle, natural size; 7, beetle, magnified; 2, eggs.

The beetle, which is especially known as *the* Mustard Beetle, is the *Phædon betulæ*, Linn., formerly known as *Chrysomela betulæ* (figured above, natural size and magnified). It is oblong-oval, hardly the sixth of an inch in length, of a full blue or deep greenish colour above, and so brightly shining as to be of an almost glassy lustre. The legs, horns, and body beneath are black. The thorax or fore-body is very minutely punctured, the wing-cases having punctured striæ, with the spaces between the striæ also punctured.

* For Beet Carrion Beetle, which is sometimes very destructive to Mangolds, see this heading.

These beetles pass the winter in a torpid state, in any convenient shelter near the fields where they have been in the autumn. In the spring they become active again, and spreading to whatever food-plant may be near, they lay their small eggs and die.

The grubs, or larvæ, which hatch from these eggs,* are of the shape shown in fig. 1 (p. 151), and are from about three-sixteenths to a quarter of an inch in length when full-grown, slightly hairy, of a smoky colour, spotted with black, with black heads and stout black conical horns, lighter at the base. They have three pairs of claw-feet, and a caudal foot, or proleg, at the end of the tail, and a row of tubercles along each side, from which the grubs have the power of protruding a yellow gland. These voracious grubs devour far and wide, until when full fed they go into the ground to change to chrysalids. In this state they are said to remain about fourteen days, and from these chrysalids the summer brood of beetles comes out which often spreads devastation over the Mustard crop, then in an advanced state.

The first observation (as far as I am aware) of remarkable appearance of this pest was in 1854, when Prof. Westwood, in reply to enquiry regarding beetles sent him for examination, stated:—"The little beetles which are attacking the White Mustard crops in the Fens, near Ely, are the *Chrysomela* (*Phædon*) *betulæ*. *Such a fact has not previously been recorded.*" After this date the attack of the Mustard Beetle, commonly known as "Black Jack," was reported at intervals, until in 1885 it was noticed as having become such a frequent and serious evil as to need investigation, and in 1886 circulars were issued by the Royal Agricultural Society of England, requesting observations from Mustard-growers regarding the habits of the beetle, and measures found serviceable for preventing its ravages. An abstract of the information received was formed by myself (as Entomologist of the Society) into a report printed in vol. xxiii., pt. 1, of the second series of the Society's Journal, and the contributors' information was given in detail in my own Report on Injurious Insects for 1886. From the above notes a portion of the following observations are taken.

Where spring attack comes from.—The observations showed that this was from almost any kind of available winter shelter. The beetles were stated to lie dormant during the winter in pipes or reeds; in the ends of old Mustard-stocks left on the

* I have identified the grub from specimens kindly procured for me by Mr. George Moore, of Wisbech, from Mustard-plants near Ely, which enabled me to trace the insect from larval condition up to its perfect state, and confirm the figure and description given (doubtfully) by John Curtis in his 'Farm Insects' as being *certainly* that of the larva of the *Phædon betulæ*.—(E. A. O.)

land; and likewise in the root-ends of Mustard-stubble, which is left on the land when the crop is cleared, and they may be found lying on the land all the following winter in the young Wheat. They shelter during winter in Mustard-stacks and temporary walls formed of Mustard or other straw, and they also winter in crevices of old wood; between the bark and the wood of old decayed trees; in cracks of gates, of gate-posts, and of posts, rails or farm buildings. They are to be found in rough grass and rushes which grow by the side of marsh-ditches, and in the earth at the bottom of the hedge-rows of fields in which Mustard has been grown the previous year, likewise in the earth of drain-banks. They also shelter "in all kinds of rubbish," in "heaps of rubbish"—"in anything that will shelter them."

From special observations, it also appeared that the insects would live through the most severe winter in pipes of the Reeds and Rushes in ditches—in fact, as has been noticed in the case of many other insects, they were not injured by cold so long as they were not disturbed from the shelters *which they had chosen, or made for themselves.*

Prevention and Remedies.—Where Mustard is largely grown the point mentioned above, of the beetle sheltering itself in what may be called the rubbish of its own crop, would be well worth consideration.

Mr. W. Little, of Stag's Holt, March, mentioned, "Some years ago nearly all the Mustard-straw was burnt when the crop was threshed, which was generally in the autumn; but now a good deal is saved to make rough sheltering walls for cattle, and the cottagers beg a few loads and make use of it for covering their sheds or hovels."

If the plan is still ever followed, which was in use some years ago, of separating the seed from the straw on the field, burning this straw in small heaps on the land would get rid of the shelter, and return much of the material otherwise carried off the field to the ground; or, if left at hand in one heap, it might act as a trap, and a large amount of pests be destroyed by firing it during the winter. In any case collecting the Mustard-stubble and burning it, and, as far as possible, getting rid of some at least of the many kinds of sheltering rubbish of which only an abstract is given above from the detailed notes of the contributors,* could not fail to be of service.

Where a district has become infested by the Mustard Beetle, the only sure method of getting rid of the insect is considered to be the combined action of the farmers not to grow Mustard for a time; or, where the attack is less widely

* 'Report on Injurious Insects for 1886,' by Ed., pp. 59, 60.

spread, to cease growing the crop for a while on infested farms.

This point (of discontinuance) is very strongly urged by the reporters. To be a complete cure, it is also desirable to discontinue the growth of Cabbage and other allied plants on which the beetles feed, though the following observation shows that this is not essential for general practical benefit:—

"The only thing to be done when a farm becomes infested with the pest, is to discontinue the growth of Mustard for a few years. This has been found to answer. Though the insects can live on other plants, they certainly diminish in numbers and almost entirely disappear in the course of two or three years, if there is no Mustard in the immediate neighbourhood.

"Burning the straw and chaff is, I think, desirable, where the insects are numerous." — (W. C. Little, Stag's Holt, March).

As with other crops which suffer under leafage being eaten away, all measures are useful which by methods of cultivation and preparation of the land and good manuring will help to push on plant-growth past harm from common amount of attack.

Superphosphate drilled with the seed is especially noted as serviceable, and generally the application of superphosphate and dissolved bones, and "any rich manure," and artificial manure is noted as necessary to secure a crop on old broken-up land. An instance of this was given in a crop to a part of which none was used, owing to the application of a heavy dressing of farm-yard manure.

"This was not half the value of the rest of the field. . . . Proctor and Ryland's special Mustard manure is very serviceable, the object *being to promote a healthy and rapid growth* out of the way of the insects."

Dressings thrown on the plants with a view to checking attack appear to have been a total failure. Lime, soot, salt and sulphur were sifted or sprinkled without effect. Jey's fluid, and rock-oil, likewise did no good, and carbolic acid is distinguished as having "only killed about 10 per cent. of the beetles, although strong enough to kill the plants."

The German method of clearing beetles by shaking them off the plants into pails or any other convenient vessels, and destroying them was tried by two observers. One reported it to be expensive and not of use, while the other stated that, by keeping two men regularly at work at the operation, it so far answered that he considered that he thus saved his crops from being destroyed. Where this plan is tried, the shaking or picking should be done early in the morning or on dull days when the beetles are sluggish.

Ploughing in the crop at once, when failing under beetle-attack, was noted as a means of saving further infestation by burying down the eggs (which would otherwise have started a new brood), or by killing the insects which would have migrated.

A special note was given of such bad attack that it was no good trying to save the crop, and on May 4th the marsh, 29 acres was ploughed and sown with Oats; . . "all the under part of the Mustard was covered with eggs which, if the plant had been allowed to stand, would undoubtedly have hatched out; when the leaves wilted the eggs perished."—Ernest Smith, Southminster, Maldon, Essex.

The difficulty of the migration of the pests in a body, or their destructive onward progress across a field, appears to be best stopped by burning straw, especially damp straw, in a line across their line of march.

"From a Mustard-field they troop off to any neighbouring field where plants of the same tribe are to be found. They will completely devour a field of Rape if it is in a young stage, and a crop of Kohl Rabi, with bulbs as big as an orange, may sometimes be seen with the leaves bitten off by these insects, nothing but the rib of the leaf being left. At this period they seem to make little use of their wings. I have stopped their progress completely by burning damp straw in a gateway through which they were passing, but previously they fly vigorously. No attempts appear to be made to check the pest, excepting the above plan of occasionally burning straw or stubble to arrest their progress when moving from one crop to another, or burning the straw or haulm after the crop has been reaped, by which means great numbers of the beetles which had sheltered in the hollow stems of the plant are destroyed."—(William C. Little, 1883.)

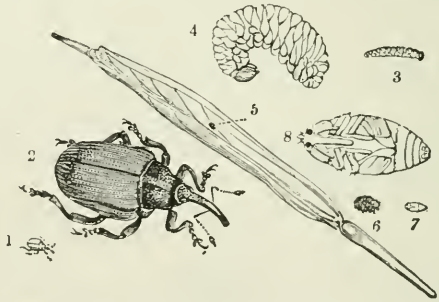
Where a shallow trench can be cut across the line of advance and filled with tar, this has also been found to answer.

The above observations refer to the true Mustard Beetle —the *Phædon betulæ:* but besides this especial infestation, the Mustard crop suffers from the attacks of the Turnip Fly or Flea Beetle whilst still in its first leafage; later on in the growth of the Mustard-plant, just when it is knotting for flower, the opening buds and blossoms are very often attacked by large numbers of the Turnip-blossom Beetle—the *Meligethes æneus*. This is a small beetle, of much the same shape as the Mustard Beetle, and, as far as I gather, it is frequently taken for it, but it is distinguished by its much smaller size, being little more than one-twelfth of an inch in length, and

commonly of a duller or more brassy green than the true Mustard Beetle.

Meligethes æneus, Fab.: Beetle and maggot magnified; and infested flower (after Dr. Taschenberg). Jaws and antennæ of maggot, much magnified.—Ed.

Besides the above-named beetles, a small dark-grey long-snouted beetle, commonly called the "Turnip Weevil" (a kind which destroys the seeds of various plants of the Cabbage tribe when they are formed in the pods), was also to be found, together with the flower-beetles on the blossoming heads; scientifically, this is the *Ceutorhynchus assimilis*.



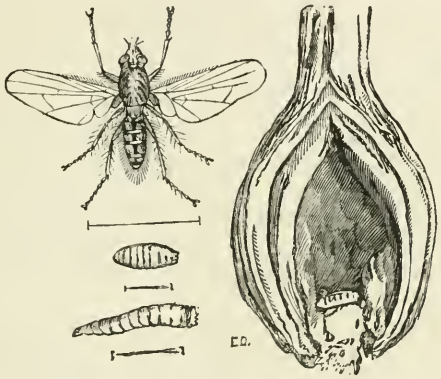
Ceutorhynchus assimilis, Payk.: Beetle, maggot and chrysalis, nat. size and magnified. Infested Turnip-pod.

ONION.

Onion Fly. *Anthomyia ceparum*, Bouché. = *Phorbia cepetorum*, Meade. **Shallot Fly.** *Anthomyia platura*, Meigen.

The injury in this case is caused by the maggots of the Onion Fly feeding inside the Onion-bulbs, which partly from the quantity gnawed away, and partly from the decay caused by the workings, are often completely destroyed.

These maggots may be found as early as May, whilst the Onions are still very small, and the form of attack ascribed by John Curtis and other writers to the *Anthomyia ceparum* (now distinguished as the *Phorbia cepetorum*, Meade), is stated to begin by the fly laying her eggs on the leaves of the Onion close to the surface of the earth, from which point the maggots make their way between the leaves into the lowest part of the Onion-bulb, where they may be found in numbers



Onion Fly, maggot, and pupa; magnified. Pupa in stored Onion. Lines showing nat. size.

varying from two or three upwards. Here these yellowish-white legless maggots, of the shape shown magnified in above figure, feed for a fortnight (or at least not for any length of time); then they usually leave the bulb and enter the earth, and there turn into chestnut-coloured pupæ or fly-cases formed of the hardened skin of the maggot, of the oval shape also figured above.

From these the fly comes out in from ten to twenty days, in summer, and almost immediately lays her eggs, and thus starts a new attack on the Onions which may have escaped before; and so the destruction goes on as long as any of the Onions remain and the warm weather continues.

The fly is figured magnified, with line showing nat. size in spread of the wings, and as described by John Curtis. The male is ash colour, with black bristles and hairs; the face white, with black horns; three dark lines along the body between the wings, and a row of long blackish spots along the abdomen; the female more ochreous or ashy grey, with yellowish white face. The flies may be found throughout the summer, but such of the maggots as turn to pupæ in the autumn remain in that state till the following spring, and then come out as flies in April or May.

Up to the year 1882, as far as I am aware, the injury to the Onion crops in this country was commonly supposed to be caused by only one kind of Onion Fly, but in the course of that year specimens of maggots infesting Onions in various localities were sent to Mr. R. H. Meade, of Bradford, from which he reared another species, the *Anthomyia platura* of Meigen, sometimes known on the Continent of Europe as the Shallot Fly.

These two species were very much alike in appearance, but do not seem to be quite similar in position of egg-laying, which is important practically.

From the observations I had the opportunity of making carefully in my own garden, I found attack was generally begun, not by deposit of eggs on the leafage, from which eggs the maggots might eat their way down into the bulb, but from eggs laid either quite at the base of the bulb, or at the lower part of the side. I submitted some of these maggots to Mr. R. H. Meade, and results showed that they were larvæ, not of the *Phorbia cepetorum* but of the *A. platura*, otherwise the Shallot Fly.

The kind of attack does not appear to depend on the age of the Onion, as in the case of maggots forwarded by Mr. Malcolm Dunn, which were attacking Onions at Dalkeith whilst still so young that hardly any bulb was formed; these were found in due course, by Mr. Meade, to be of both of the above-named kinds. As shown further on, knowledge of the habit of attacking the bulb may be most serviceably made use of in preventing attack.

Prevention and Remedy. — One of the first points to be attended to is cleaning the ground from infestation.

The pupa or chrysalis of the autumn brood remains in the ground, or sometimes in decayed Onions, during winter, and the fly comes out from it in time to attack the young Spring Onions; therefore Onions should not be grown two years running on the same ground. It has been observed that the fly, when buried a few inches deep, has much difficulty in coming up through the ground if it is at all firm. For this reason, when Onion-beds have been much infested, it is a good plan to deeply trench the ground, turning the top spit into the bottom of the trench. By this means the fly-cases are buried so deep that the flies cannot come up from them, and also the cases are not brought up to the surface again by the common routine of digging or cultivation; it would probably answer every purpose, as far as keeping the fly from coming up is concerned, if the surface was simply turned down one spit deep; but it should always be borne in mind that the

pupæ should be left down till dead. If ground with buried pupæ that naturally hatch in April is turned up again in March, no good will have been done by burying them.

For measures directly protecting the bulb from attack.—It was plain that the flies *must* lay their eggs somewhere, and if they could not get at the right place (for them) to lay them in, the eggs must be dropped where they either would not hatch or the maggots would perish. I found the eggs in such cases were laid too far up the leafage of the Onions to do any mischief, or were merely dropped on the ground. During two seasons I experimented on the effect of covering Onion-bulbs up to the neck, or rather higher, with earth, and the plan answered so well that I tried on a more definite plan and with great success.

During January in 1884 I had a trench dug as if for Celery, and in this good manure was laid and covered over with a few inches of earth. At the usual time in the spring I sowed Onions along the trench, disturbing the soil as little as possible, and also sowed Onions in the bed alongside. As the plants grew I had the earth from the sides of the trench gradually worked down upon them, which kept the bulbs fairly buried throughout the season, and also kept down the weeds. The row of Onions next the trench was also kept more or less covered, as the earth lay conveniently for spreading over the bulbs.

The Onions in the trench throve remarkably well, and throughout the season there was hardly any attack of Onion Fly on these; those by them did well, but not so markedly; and on Sept. 10th, when the crop was raised, those from the trench gave a yield of sound and good bulbs, many of them very fine. Samples of these which I forwarded to the inspection of Mr. J. Chalmers Morton, Ed. of the 'Agricultural Gazette,' were pronounced by him to be satisfactory, and my plan has since been tried with success in Canada.

There might be difficulties in carrying out this plan on a large scale, but in many cases it would answer well to have beds slightly ridged for Onion growing. Thus the earth would not fall away and leave the bulbs exposed; the weeds amongst the Onions would be smothered. Also, when thinned (which is an especially dangerous time relatively to Onion Fly attack) the plants could be firmly fixed by the earth being hoed down on them, instead of being thrown open to attack by being loosened in the ground just when the smell of the bruised plants may be presumed especially to attract the fly.

The maggot infested Onions may be known by their leaves fading and turning yellow, whilst the inside of the bulb becomes decayed.

These infested Onions should be cleared out of the bed at once. This is a most important point, and if thoroughly done will much lessen the amount of further attack because thus the maggots that would have developed into the next brood of flies will be got rid of.

A common rough way of proceeding is to pull up as much of the Onions as will come, but they ought to be taken up by a spud, or old knife or any implement that will raise the whole of each decayed bulb, and the maggots in it, up together. The Onion that is badly attacked becomes a rotten mass towards the lower part, with the maggots inside it just covered by the skin of the bulb. If the leaves are pulled at they come up easily, but the decayed base of the bulbs, and many of the maggots, remain behind. These are perfectly able to make their way to the neighbouring Onions and consequently though the bed looks better, it may happen that very little good has been done.

The infested bulbs, maggots and all, as they are removed, should be put carefully into a pail or tub or vessel of any kind out of which the vermin cannot creep, and be carefully destroyed. The importance of this was shown in 1882, in the gardens at Longleat, near Warminster. Mr. W. Taylor reported that some of the Onions showed signs of flagging whilst still only about the thickness of a knitting-needle. Every Onion so affected was pulled up, carefully placed in a basket, and *carried straight to the stoke-hole fire.* The plants were treated in this way every two or three days for three weeks, and the result was that there was no further damage, and the crop of Onions was good. Mr. Taylor added the very noteworthy observation that one of his garden men followed the plan so far as to pull up all the faulty Onions in his garden, but he *threw them down a short distance from the bed,* and lost his entire crop.

With regard to special applications for prevention of the maggot, various forms of spraying or watering with mixtures of paraffin oil (carefully applied at not too great a strength) have been useful; and various other dressings, liquid or dry, suited both to encourage growth and make the ground obnoxious to the fly, have been reported as serviceable. Amongst these it is probable that the mixtures of paraffin oil would be both more satisfactorily applied, and more safely for the leafage, if mixed thoroughly with soap-wash than only diluted with water.

During the past few years great advances have been made in the methods of application of mineral oils as insecticides, and references to these will be found under headings of "Soft-soap-wash," &c., in Index.

In one locality when the maggot appeared, paraffin oil was mixed with water in the proportion of a pint to two gallons of water, and with this the Onions that were planted in rows were watered through the spout of the can without the rose. It was noted that the paraffin should be used carefully in dry weather, lest it should burn the plants.

Another method of application was to mix a good glassful of paraffin oil with about six gallons of water, and throw this mixture carefully as a spray over the Onion-beds; this cured the maggot-attack after two or three applications.—(J. W.)

In another locality the only means found serviceable for prevention of maggot-attack was the use of sand saturated with paraffin oil, and sprinkled amongst the Onions, this sand being afterwards watered by means of a can with a rose. In this case experiment was made as to the direct effect of paraffin on Onion-maggots, and twenty-four hours after the application of three drops of paraffin to the soil in a flower-pot containing some young Onions and Onion-maggots, these maggots were found, on examination through a magnifying glass, to be (with the exception of two) all dead.—(G. M'K.)

Soap-suds were noted as very useful; it was found that there was no trouble with the maggot where watering with soap-suds was freely given on its first appearance; the suds usually destroyed the maggot in two or three applications, and also nourished the Onions.—(P. L.)

It is a good plan to pour the suds over the plant through the rose of a watering-can, so as to make them disagreeable to the fly, as well as effective to the grub in the ground.

The ammoniacal matter contained in house-slops make them a valuable manure for Onions. They may be applied with advantage to the growing plants, and, in cottage gardens, good crops are taken off ground where these slops have been thrown during the winter, and the bed dug and sowed in the spring.

Liquid manure from farm-yard tanks, diluted with water till reduced to a safe strength, has been found useful; also the use of liquid drainings from pig-sties have been observed to give good crops when all others in the neighbourhood have failed by maggot-attack.—(J. K.)

A heavy watering, to render the fertilising matter in the soil available, is often of much service in running the growth on healthily without check in dry seasons.

Soot, charcoal dust, and pulverised gas-lime, have all been found of good service in checking attack; but probably the use of ground clean from the Onion Fly to start with, and so prepared that a healthy vigorous growth is likely to take place, a watchful eye to remove infested plants as soon as they show,

and the immediate application of a strong drenching of the fluid most obnoxious to the grub that can be found, are better than dressings not rapidly soluble, for the fluid goes down at once and lodges in the maggot-holes.

To the above I may add that the worst cases of maggot-attack I have seen followed sowing on ground which was not prepared beforehand, and had not received a special dressing of manure.

Guano is recommended by some growers, but I have known such severe attack of Onion Fly accompany its use as a dressing that I have not mentioned it as desirable.—(Ed.)

PARSNIP.

Carrot and **Parsnip Fly.** "**Rust.**" *Psila rosæ.*
Parsnip and **Celery Leaf-miner.** *Tephritis onopordinis.*
Carrot-blossom Moth. *Depressaria daucella.*
Carrot and **Parsnip-seed Moth.** *Depressaria depressella.*

Parsnip and Celery Fly, magnified; line showing nat. size; larva and pupa figured in blistered leaf.

I am not aware of the Parsnip being seriously injured in this country by any insect peculiar to itself. Its chief enemies are those above mentioned, which are noticed under the heads of insects infesting Carrots and Celery.

PEAS.

Pea Moth. *Grapholitha pisana*, Guénée.

1, Caterpillar on Pea; 2, caterpillar magnified; 3 and 4, moth, nat. size and mag.

The caterpillars of this moth cause the "worm-eaten" or "maggotty" Peas often found in old pods when the crop is maturing with the insides eaten away, and partly filled with, and partly surrounded by, the excrement left by the caterpillar.

These caterpillars or maggots are fleshy and slightly hairy, about or somewhat more than a quarter of an inch in length, and are generally yellowish in colour, with a black head, a brown band on the ring next to the head, and eight brown dots on most of the following rings. They sometimes, however, vary in colour; in some specimens the head and the next ring are brown, and in some they are intensely black. The legs on the three rings next to the head are black.

The caterpillars go down into the earth to change, where they spin a cocoon (that is, a kind of egg-shaped covering formed of silken threads drawn from the mouth) in which they remain till spring, when they turn to chrysalids, out of which the moths appear in June.

The moths are rather more than half an inch in the spread of the wings, satiny, and mouse-coloured. The upper wings have a row of very short white streaks directed backwards from the front edge, and have a silvery oval ring with five short black lines inside it placed near the hinder margin.

Although maggotty Peas are one of the commonest of infestations, the attack appears to be so little thought of that enquiry is very rarely made about it. I have therefore merely given above the short notice of the moth and its method of causing the infestation published by John Curtis in his 'Farm Insects,' and below some of the methods of prevention of

recurrence of attack which obviously could not fail to be of service.

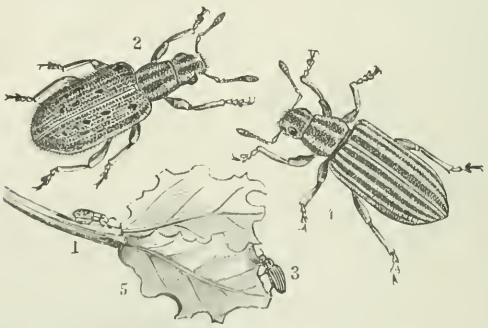
Prevention and Remedies.—In gardens where maggot-attack is noticeable in the pods, the Pea-haulm should be cleared away directly the crop is gathered, so that all stray pods (which are very likely to be infested) may be cleared off the ground before the maggot can go down into it. This haulm should be carefully destroyed at once; the safest way is to burn it, and it would be a very good plan to lay the haulm and any other combustible rubbish at hand along the rows where the infested Peas stood, and burn it there, so as to get rid at once of all grubs remaining in the pods or quite near the surface of the ground.

For field treatment, as the haulm could not well be spared, it would be desirable, if a Pea-growing district was infested, to plough deeply, so as to bury the chrysalids well down during the winter; or to skim the surface lightly, so as to throw them open to attack of birds. But commonly the regular rotation of crops might be expected to prevent this infestation getting ahead.

In garden treatment it might be worth while to watch whether the little grey moth infested the Pea-plants during flowering time, especially in the evening, and in case they were noticeable in any great numbers it might make a difference in the amount of egg-laying to dust the plants with any powder dressing as soot, &c., which might be obnoxious to the moths, but would not do harm to the leafage or blossoms.

Pea and Clover Weevils.

Sitones lineatus, Linn. (and other species).



1 and 2, *S. crinitus*; 3 and 4, *S. lineatus*, nat. size and mag.; 5, leaf notched by Weevils.

These beetles are often very injurious to the leafage of Peas, as well as to that of other leguminous crops, as Beans, Clover, &c. The attacked crops may be known by the leaves being scooped out at the edge, as figured. The beetles begin their work at the edges of the leaves, and gradually eat their way onwards, until, in bad attacks, nothing is left but the central rib, or merely the leaf-stalk.

Great numbers of the weevils appear in March and later on, and do great mischief, but up to the year 1882 the place of deposit of the eggs, and the history of these weevils in their early stages was still as completely unknown as when Curtis, in his 'Farm Insects,' mentioned of the *S. lineatus* that "it still remained to be ascertained where the eggs are deposited"; and of the *S. crinitus* (more in detail), "No one knows where the female lays her eggs: no one knows where the maggots feed, or where they change to pupæ."

In the course of the spring and summer of 1882, the long-needed observations of where the maggots of these two kinds of the destructive *Sitones* weevils feed and turn to chrysalis state were made respectively by Mr. T. H. Hart, of Park Farm, Kingsnorth, Kent; and by Mr. Reginald W. Christy, of Boynton Hall, near Chelmsford, Essex.

On the 31st of May Mr. Hart, in the course of special examination of his Pea-roots, found many weevil maggots. Some of these were lying along the main root, which bore marks of channels having been eaten along it, but in many cases they appeared to be feeding on the soft gall-growths often to be found on Pea-roots.

These maggots, of which specimens were sent me, were, when full-grown, about a quarter of an inch in length, white, plump, and wrinkled, with a brownish horny head furnished with strong jaws, legless, but using the end of the tail as a kind of foot to help them in progression. When full-fed the maggot formed an oval cell (without a lining) in the earth, about two inches below the surface, in which it changed directly to the chrysalis state. In this state it is like the perfect weevil, only with the limbs folded beneath it. At first it is white, but as it matures the eyes become black and proboscis pitchy. The weevils brought in from the field reached the perfect state by the 6th of July; those left in their natural position in the field did not mature until somewhat later. The Striped Pea Weevil, *Sitones lineatus*, is of an ochreous or light clay-colour, with three whitish or ochreous stripes along the back, and with ten punctured *stripes* alternately of a darker and lighter clay-colour along the wing-cases; the horns and legs are reddish. The markings of the beetles only show well on fresh specimens, as they are

caused by the various-coloured scales with which they are thickly covered; after a while these scales get more or less rubbed off, and then the black skin of the wing-cases appears in patches. Mr. Christy's observations referred to the Spotted Pea Weevil, the *Sitones crinitus;* this differs from the above in being rather smaller, and more of a grey or rosy colour, with short hairs; and in the wing cases, which have short bristly hairs down the furrows, being *spotted* with black.

In this case Mr. Christy first observed the weevil-maggots at the roots of Red Clover, on the 23rd of March. The Clover land infested was a field of 24 acres, 12 of which had been in Wheat, and 12 in Barley in the previous year; and it was noticed that the maggots were much more plentiful on the solid Wheat land than on the looser Barley land. Two, three, or in some cases as many as five or six, maggots were to be found under one plant. Some of them were to be found at or near the tap-root of the Clover, and some at the extremity of the smaller roots, which showed injury from their gnawings. None of the grubs were found between the rows of Clover. Like the larvæ of the *S. lineatus* above-mentioned, they were about a quarter of an inch long, legless, and much wrinkled, and of a whitish colour. The head was ochrey and furnished with dark brown jaws. Some of the specimens sent ceased feeding and formed hollow chambers in the earth by the 8th of May, and at the end of May and beginning of June some were turned to chrysalids. By the 26th of June most of the maggots in the field at Boynton Hall were reported to have (as far as was observable) changed to chrysalis state, and the weevils, from the earliest formed chrysalids, began to appear about the 20th of June. This gives the early summer part of the history. Later on there were, in the year observed, great numbers of weevils to be seen.

In the autumn Mr. Christy, continuing his observations, noted on the 21st of October, "The roots of Clover have now no larvæ near them. I have examined a great many. On 23rd of November, examination of a great number of Clover-roots showed presence of *Sitones* maggots *in all stages of growth*, some evidently just hatched, others nearly or full-grown; and examination on the 28th of December and the 11th of January following showed maggots, sometimes full-grown, but never in chrysalis condition."

Thus we have the history,—the commencement of attack in autumn, originated by the summer brood of beetles; and presence of maggots at the Clover-roots recorded at intervals during the winter, until in spring they turn to chrysalids,

from which the beetles come out in June; and to this—though possibly some of the beetles visible in March may have developed early—we must add the presence of the hybernated specimens which have lived in shelter through the winter.

Prevention and Remedies.—Some little could be done to begin with, in years when attack is prevalent, by destroying the weevils "wholesale." In 1882 Mr. Christy noted they were so plentiful that "at harvest-time the weevils were abundant on the young Clover, the platforms of the 'reapers' being literally covered by them, and they could be swept out of the carts when carrying Peas and Beans by thousands." And in the following year Mr. D. Turvill, writing of the vast number of these pests on his land near Alton, Hants, mentioned the Peas were swarming with weevils; they lay thickly covering the floor of the waggons, and in the barn were creeping away from the Peas and covering everything. Under such circumstances, sweeping them down into pails of any sticky mud which would stifle them, or on to tarred boards, would be a simple way of preventing multitudes from flying to the Clover-fields to lay the eggs which start the autumn brood, or secreting themselves in winter shelters to continue damage to leafage early in the following spring.

Sometimes they may be found hybernating outside Clover-stacks; sometimes in the fields down the pipes of stubble. The Rev. J. C. Clutterbuck, of Long Wittenham, Abingdon, who gave much attention to this subject, wrote me,—"We traced the sometimes total loss of *Trifolium* to this source, as we found the insects in the top joint of the stubble, amongst which we generally drilled the *Trifolium incarnatum* without ploughing. We lightly skimmed the stubble, and so deprived the weevil of its habitat and refuge; and we believe we abated the evil."

After a heavy snowstorm early in January in 1888, great numbers of these *Sitones* beetles were found by Mr. Christy in a torpid state, on the surface of the snow in a field of Barley stubble, where the tips of the stubble were just above the snow. Apparently these had crept out from their shelters during or after the snow and been caught by the sharp frost.

It appears very doubtful whether top-dressings would have any effect in killing the maggots in the ground, but they might do a great deal towards lessening the amount of damage from their presence. In the experiments tried at Rothamstead in 1889 (see p. 54), relatively to checking Clover stem-sickness, the applications of sulphate of ammonia and sulphate of potash mixed pushed the plants well

on past the Stem Eelworm attack, and gave a very good result as to plant growth, although they had no apparent effect on the *Sitones* maggot, which remained at the roots in plenty, and this point is well worth consideration. These weevil maggots, as in various instances recorded in 1882, both to Peas and Clover-crops, are capable of causing injury, and it is in only some cases that destruction of stubble can be managed in order to clear the beetles (as a preventive measure); but manuring to standing crops to push them into growth, and to young crops cultivation and manuring of the land, suited to push on a hearty and rapid growth from the first sprouting of the seed, are important means of lessening damage respectively from the maggots below ground or the beetles on the leafage.

Pea-crops suffer most from attacks of the weevil in their early stages of growth, as at this time the plants are tender and the leafage young, and therefore more liable to injury; also the number of beetles that would do but little harm to a fairly grown plant soon destroy one with only a dozen or so of leaves. It should be kept in view that a stunted growth, whether caused by the nature or method of cultivation of the soil, or the character of the season, increases the evil by keeping the plants back for a longer time in this critical stage of growth.

To obviate these difficulties it is desirable to provide a good seed-bed, friable, sufficiently moist, and rich in available plant-food, which may be obtained to a certain extent by Peas following Cabbage or root-crops in the rotation.

In garden cultivation, besides the liberal supply of manure needed to run on a healthy growth, it has been found to answer well "to put a little broken turf and wood-ashes along the drill, sow the Peas on this, and cover them with a little more of the same."—(J. S.)

The attacks of the weevils are noted as being worst in dry weather, and good syringings with water, or any addition thought fit, such as would make the plants distasteful to the beetles and encourage healthy growth, would be serviceable.

As far as I am aware, it was generally supposed, up to last year, that the *Sitones* fed by day, and sheltered themselves by night beneath clods or under any convenient protection. In Curtis's 'Farm Insects' he notices that, in a specially bad attack of these weevils, which took place near Hertford at the end of March, 1844, "At this period of the year they issued from the ground from 9 to 10 o'clock in the morning, to feed all day upon the Peas, and they retired under the clods of earth on the approach of evening." He also quotes an observation of their method of feeding, when (after long

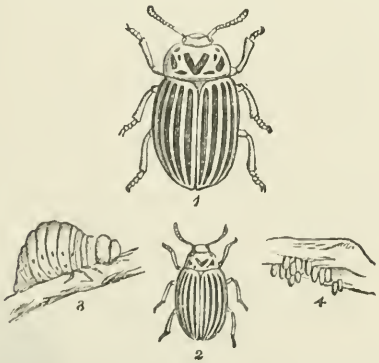
waiting on account of their shyness under observation) they were then "observed to feed by taking the edge of the leaf and holding it steadily between their legs," whilst they devoured it as described.

In last year, however (1889), the Rev. Theodore Wood, F.E.S., mentioned to me that he did not think that he had "ever gone out with a lantern by night, and examined a row of growing Peas or Beans, without finding the beetles upon the leaves in hundreds, all busily nibbling away at the edges. At such times they are not nearly so susceptible to alarm, and do not fall at the vibration of a passing footstep." . . . "I also find that a thick layer of soot is as efficacious as anything for keeping them away. Only this must always be renewed after a shower of rain."

It was also noted, by Mr. Malcolm Dunn, of Dalkeith, an excellent authority in matters of injurious insect prevention, that "a dressing of lime or soot given to the Peas (wetting them first to make it adhere) was an easily applied and generally effective remedy." Any dressing that was distasteful to the beetles, which could be thrown on the ground along the rows of Peas, and fill in the crannies down which they hide when disturbed from their work above, would help to lessen the mischief.

POTATOES.

Colorado Beetle. *Doryphora decemlineata*, Say.



1 and 2, Colorado Beetle, magnified, and nat. size; 3, caterpillar; 4, eggs.

This beetle is not mentioned here as a "British Injurious Insect," nor as one which (from the experience and knowledge of its life-history gained since 1877) can be deemed likely to be injurious to a serious extent in this country. It is however of interest just to notice it, as at the above date the steady eastward advance of the pest raised grave fears of this scourge to the American Potato crops gaining a footing in this country.

The eggs, figured p. 169, are laid on the young shoots or beneath the leaves of the Potato; the grubs are orange or reddish, and change to pupæ in the ground; and the beetles are also distinguishable by their orange colour and by having (besides a large black spear-shaped mark on the back) *ten* black stripes on the wing-cases—five stripes upon each.

The natural home of this destructive beetle is in the Western States of America; and from Nebraska and Iowa it travelled eastward, until, in 1876, it reached the eastern shores of America; and in the autumn of 1877 specimens were found at Liverpool in a cattle-boat from Texas, which were identified by Mr. And. Murray (who was despatched to investigate the matter officially) as the "Colorado Beetle."

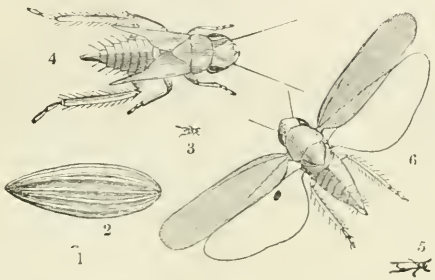
From what we now know of its life-history (as well as from the fact that, though nearly fourteen years have passed since it was first certainly known to have reached one of our seaports in this country, it has as yet made no settlement) we may reasonably believe that we are not likely to suffer from its ravages.

Should it, however, make its appearance, something (it might be hoped) would be done in the way of Prevention by the Order in Council published in the supplement to the 'London Gazette,' August 17th, 1877. By this it is provided that—If the owner of, or any person having the charge of, any crop of Potatoes, or other vegetable, or substance, finds or knows to be found thereon the Colorado Beetle, in any stage of existence, he shall with all practicable speed give notice of the same to a constable of the Police establishment of the locality (the duties of the Police are unnecessary to be entered on); but it is further provided that it shall not be lawful for any person to sell, keep, or distribute living specimens of the Colorado Beetle in any stage, and any person failing to do anything he is required by this Order to do is for *each offence* liable to a penalty not exceeding *ten pounds*.

With regard to Remedy probably there is no other injurious insect attack of which the remedy is so certainly known. The widespread practice of the United States and Canada has long shown *the* cure for attack of the Colorado Beetle to be Paris Green, and if ever we should have the misfortune to be

visited by this pest, immediate and certain measures of destruction could be applied within a couple of days of receipt of intelligence of its presence.

Potato Frog Fly. *Euptery.x solani*, Curtis.



1 and 2, eggs; 3 and 4, pupæ; 5 and 6, Frog Flies, nat. size and magnified.

This insect feeds in all its stages by inserting its sucker into the stem or leaf of the Potato, and drawing out the sap.

The eggs (figured above) are white and shuttle-shaped, and are to be found upon the under side of the Potato-leaves.

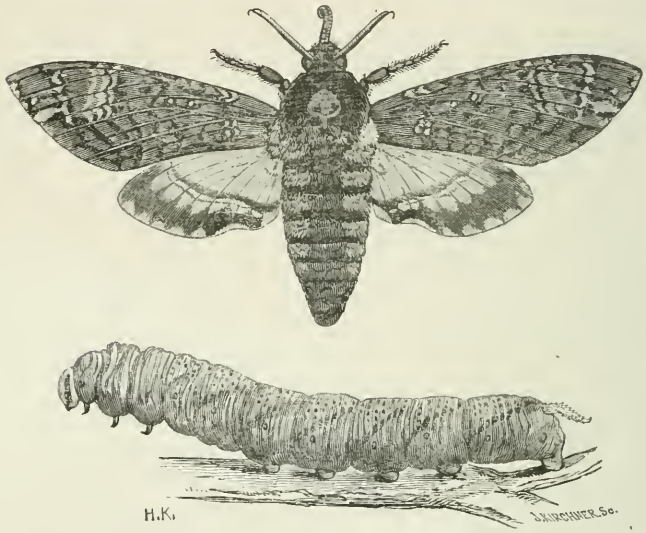
The larva, which is much like the parent Frog Fly in shape, but without wings, is green when hatched, and is furnished with six legs, two horns, and a sucker; in the next stage (the pupa) it is green, nearly as large as the parents, but narrower; with black eyes, long black horns, and a stout sucker, by means of which it feeds until ready to change to the perfect insect. It then fixes itself firmly by its six legs to a stalk or leaf, the skin bursts along the back, and through the opening the perfect insect creeps out, leaving the deserted case standing as an empty insect-skin on the plant, or fallen beneath it. This "Frog Fly" is bright green, fading after death to a yellow tint, with short horns, brown eyes, and four iridescent wings less than a quarter of an inch in expanse; the upper pair glossy, somewhat rusty at the tips, and twice as long as the body; the lower pair exceedingly delicate. The length of the insect is about a twelfth of an inch.

The flies are very nearly allied to the common Cuckoo Spit Fly (*Tettigonia spumaria*), but they have not the power, like the Cuckoo Spit or "Froth Fly," of secreting a mass of frothy matter round them in their larval stages.

It does not appear that, as yet, this fly has been noted as causing any serious mischief to Potatoes needing prevention or remedy, and I have scarcely ever received enquiries as to its attacks, but as it is sometimes very abundant on the plants

in the latter part of the summer I have inserted the above account, extracted entirely from Curtis's 'Farm Insects.'

Death's-Head Moth. *Acherontia atropos*, Linn.



Death's-Head Moth and caterpillar.

The caterpillar of this moth is sometimes found in great numbers feeding on Potato-leaves, but it seldom does any serious amount of damage.

When full-grown these caterpillars are of great size, sometimes measuring four or five inches in length. They are thick and fleshy, with a pair of feet on each of the three segments behind the head, four pairs of sucker-feet, and another pair set close together beneath the last segment which act as claspers. Above this pair, on the back of the caterpillar, is a protuberance like a tail or horn, tubercled, and bent downwards, but turned up again at the tip. The head is horny, and furnished with strong jaws. The colour is generally yellow, or greenish yellow, speckled with black on the back, with seven slanting stripes of blue or lilac on each side; the upper end of these stripes forms a kind of row of points, where they meet along the back, the lower end points forward, and is white or bordered by a white line. When about to change, the caterpillar turns to a lurid yellowish or reddish tint. It then goes down into the earth, throws off its skin, and turns to a large chestnut-coloured chrysalis. The caterpillars that

change in July come out as moths in September and October; those that change in the autumn do not come out till the following spring.

The moth is the largest of the British kinds. The spread of the wings is from four to five or even six inches. The fore wings are of a rich brown, varied with yellowish or rusty tints, with black lines or cross-bands much waved and zigzagged; they have a pale or ochre-coloured spot in the middle, and are sprinkled with small white dots. The hind wings have the margin slightly scooped out, and are bright orange, with two brown or black bands, the outermost being broadest. The head is black; the back has markings, in its thick black velvety down, of pale ochre and orange colour, exactly like a painting of a skull or death's head, whence the name of the moth. The abdomen is yellow, with six black bands across; and a line or row of spots down the centre, and the tip of the tail, are of a bluish grey colour.

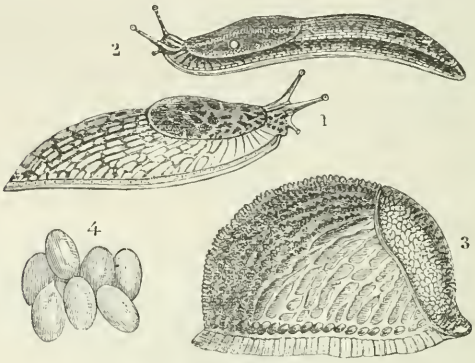
Where the eggs are laid does not appear to be noted.

When the moth is alarmed it makes a sharp squeaking plaintive cry, not unlike the squeak of a mouse. It is said to enter Bee-hives and rob the Bees of their honey, whence the name sometimes given of Bee Tiger-Moth.

Prevention and Remedies.—The caterpillar usually hides by day, and comes out in the evening or at night to feed. If it should occur in sufficient numbers to cause serious damage, it would be well for the owner of the Potatoes, or some one interested in the matter, to go through the field carefully at different times and ascertain when these great grubs are feeding. From their large size they are distinguishable in the twilight of the evening, or in a clear moonlight, so that, when it has been made out at what time they are to be found, they might be easily got rid of by hand-picking.

SLUGS.

Field or **Milky Slug.** *Limax agrestis*, Linn.
Black Slugs. *Arion ater*, Linn.; and *A. hortensis*, Ferussac.



1, *L. agrestis;* 2, *L. ater* (less than life size); 3, *L. ater* (var. *empiricorum*) in repose; 4, eggs.

Slugs are injurious to almost every kind of crop; therefore, as they can scarcely be rightly placed under any special crop-heading, I give a note of them under their own name, and this also because they are entirely different in their nature to insects.*

The true Slugs may be generally described (when extended or in movement) as being long, more or less spindle-shaped, cylindrical or tumid, head prominent, "tentacles" (commonly known as horns) four in number, and two eyes placed on the tips of the uppermost pair of horns (see figs. 1 and 2).

When at rest or alarmed they draw themselves together into a lump as shown at fig. 3.

The Field or Milky Slug, *L. agrestis*, figured above, is a somewhat spindle-shaped kind, about an inch and a third

* They belong to the Division *Mollusca*, thus described, "Animal in pairs, the body and its appendages soft, inarticulate (not jointed), enveloped in a muscular skin, commonly called the mantle, which is extremely variable in form, and has developed either within or upon it a calcareous portion, consisting of one or several pieces commonly called a shell."—Trans. from De Blainville's "Manuel de Malacologie et de Conchyliologie," given in Sowerby's 'Conchological Manual,' p. 3. The Shell Snail, "Pond Snails" or *Limnæa*, and Pond Mussels, are familiar examples of Mollusca with shells, the true Slugs or *Limacidæ* have a small morsel of a kind of shell-like formation sometimes shield-shaped placed on the fore part of the back under the skin called the mantle.

long, greyish in colour, and with milky slime; it is very common in fields, gardens and woods.

The Arions, or Black Slugs, of which one kind is figured in repose at fig. 3 (p. 174), and less than nat. size at fig. 2, are partly distinguishable by the skin being wrinkled and the shield on the back shagreened. Both kinds are common. *Arion ater* is as much as four inches long; *A. hortensis* is about the same length as the Milky Slug, but long in proportion to its size. The colour is wonderfully variable, being "brown, red, yellow, grey, greenish, or black," usually somewhat striped along the back and sides, and covered with coarse oblong tubercles; the foot (lowest surface) bordered with some shade of yellow or red, or with grey; slime yellowish or whitish.

These Arions, or Black Slugs, are stated to lay their eggs separately under ground.*

Prevention and Remedies.—Slugs, as is well known, frequent damp spots, and lay their eggs in the ground or at the roots of Grass and other plants, and come out to feed in the evening when the heat of the day is gone by, or, if the weather is mild and damp, after a shower they may be found during the day.

The time when they are out at feed is one important point to be considered in methods of prevention, and so also (and very especially) is the circumstance that the Slug can exude slime, so that it can "moult-off," as it were, a coating of lime or other obnoxious dressing thrown on it, and thus (quite getting rid of it together with the slime) be no worse for *one* application of any ordinary dressing. This moulting the Slug can do a *few times successively*, but after the operation has been repeated two or three (or at least a very few times) the creature requires an interval to regain the power; the slime reservoirs, or power of exuding slime, are exhausted for the time being, and the obnoxious dressing consequently takes effect on the skin of the Slug and kills it.

Where there is bad Slug-attack in fields, attention is particularly needed to these points. On *un*-occupied land such a heavy dressing of gas-lime, or quick-lime, or salt, may be put on, that wherever the Slug crawls there is the obnoxious stuff, and it soon loses its slime-producing power and perishes. But very often, where crops are infested, lime is only thrown in the middle of the day or at any convenient time, just when the Slugs are sheltered from the dressings falling on them,

* The above descriptions are taken from 'British Conchology,' by T. Gwynn Jeffreys, F.R.S., Vol. i., to which the reader is referred for much useful information both as to habits and scientific distinctions of the *Limacidæ*.

and as it soon slacks it does very little towards getting rid of the infestation. I have seen the Slug resting as comfortably in the slacked lime as it would under a stone.

Or again, if one dressing is given in the morning or when the Slugs are out at feed, it often happens that it is not followed up by another before the Slugs can protect themselves.

To do good the dressing should be thrown in the evening, when the Slugs are at feed, and again the following morning. If the Slugs should again reappear next evening, the dressing should be given again, but if it has been properly applied, probably there will be no need.

These common pests were reported as being very injurious at various places, during the summer in the year 1883, and the following observations give an example of the success of this treatment.

On July 31st I was favoured with a note from Lord Portman relatively to Slugs, which were causing much harm to his Turnip crops at Bryanston, Blandford. The specimens forwarded were mainly of the Field Slug (*Limax agrestis*), together with a very few of the *Arion hortensis*, sometimes known as the Black Slug.

The attack, which was to Turnips on land broken up after Clover, which had been mown in two successive years, was very severe. The Turnips had been resown twice, and on each occasion the plant had been destroyed by being eaten just above the root and below the leaf. Salt had no effect, and lime also failed.

Looking at the points noted above, I suggested that the dressings should be repeated several times, the applications following each other as near together as could be; and the result, as shown by the note given by permission of Lord Portman, was a thorough clearance.

It is mentioned:—"We ploughed a furrow round the attacked plot, and filled it with quick-lime to cut off pest invaders. We fed the adjoining land very close with sheep and cured any Slugs therein. We then dressed the Turnip land with a mixture of soot and lime in one part and salt in the other. The first day did but little good; the second doses were effectual, and, being repeated at dawn and dusk, killed the enemy.

"The soot and lime acted best.

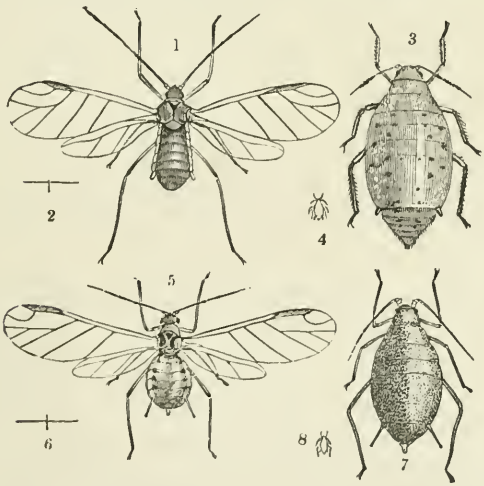
"We have now a good crop of Rape, which was sown when the Turnips were devoured, and of Turnips in the parts which were saved by repeated dressings."

This plan has been found since then to answer very well where there was bad infestation.

Disturbing the surface of the ground so as to throw out the eggs, and in gardens clearing away all the different rubbish amongst which they shelter, also strewing Cabbage leaves to attract them, and clearing the Slugs from beneath these every morning, are well-known remedies.

TURNIPS.

Turnip Aphis (Green Fly). *Aphis rapæ*, *A. floris-rapæ*, Curtis; *Rhopalosiphum dianthi*, Schrank.



1—4, *Aphis floris-rapæ*; 5—8, *A. rapæ*, nat. size and magnified.

This Aphis is common in the summer on many kinds of plants, and is especially hurtful to Turnips, Swedes, and Potatoes. It is chiefly to be found on the under side of the leaves, but sometimes occurs in such numbers as to smother the plants; and the vast swarms of Green Fly which at times fill the air, as in the autumn of 1834 and in 1868, are believed to have been of this species.

The Aphis is very variable in appearance; the wingless viviparous female is of some shade of green or yellow, but often of an ochreous-red in autumn; the winged viviparous female is for the most part black, with reddish yellow abdomen,

striped and spotted with black; ochreous legs; and wings yellow at the base, with yellow main vein; the insect is, however, sometimes entirely black, ochreous, or green. The variety *floris-rapæ* that is mentioned by Curtis as found on flower-stalks of the Turnip is described by him as dull pale green, dusted with white, and with dots and markings of black.—('Mon. of Brit. Aphides'; 'Farm Insects.')

Prevention and Remedies.—The great difficulty in field-cultivation has arisen from the want of any implement adapted to distribute fluid-dressings in the requisite manner at a reasonable cost.

This difficulty (so far as trials of experimental workings show) has been removed by the invention of the pneumatic drill known as the Strawsonizer. So far as we see the workings, this implement would be precisely what is needed for remedy of this attack. The spray could either be distributed gently, so as to coat the leaves with the dressing *above* and *below;* or it could be driven with a power which would at once wash off not only vast numbers of the Aphides (lice), but also the filth accompanying, to the great benefit of the plants; further, the refreshment of the plant, from the general moisture of the washings which would run down into the earth, would of themselves be a great help against the Green Fly, which is worst in the hot weather, and multiplies most quickly on plants failing under drought.

Wherever the state or arrangement of the crop allowed the implement to be drawn along the drills, as good results might be expected in washing for Turnip as for Hop Aphis.

With regard to the nature of the applications, one great difficulty in counteracting Aphis-attack arises from the skin of the Aphis being often of such a nature, or covered with a mealy secretion of such a nature, as repels water, and consequently many of the applications simply run off them, without doing us any good; but if a basis of soft-soap is given, so as to make the wash adhere, whatever Aphis-poison is preferred, such as quassia, paraffin, or any other deterrent, will do good.

A proportion of twenty-eight pounds of soft-soap, and half a pound of tobacco, in a hundred gallons of water, is a well-known wash for clearing Hop Aphis, and would be likely to answer as well for the Turnip pests.

I have myself found soft-soap and paraffin wash answer well, and as the recipe is one of the surest and simplest that I have met with, I give it as placed in my hands.

The proportions and plan of mixing were worked out by the late Mr. Alex. Shearer, while at Yester, Haddingtonshire:—"To eight parts of soft water add one part of black (soft) soap,

and boil briskly for a few minutes until the soap is thoroughly dissolved. While boiling add paraffin, or any similar mineral oil, and boil for a minute or two longer, when the whole will be thoroughly amalgamated. The strength of the solution of course depends on the amount of mineral oil in it, and it can be easily reduced to the proper power by mixing it with soft water as it is wanted for use."—(A. S.)

Paraffin oil, in the proportion of one wine glassful (that is half a gill) to one gallon of water, is considered strong enough to kill Aphides.

The mixture would, as matter of course, require to be tested as to effect on leafage before trying it on a large scale.

I was indebted for the recipe to Mr. Malcolm Dunn, Superintendent of the Duke of Buccleugh's gardens at Dalkeith, Scotland, where the recipe was regularly used, and considered safe and serviceable, and Mr. Dunn especially noted that the important point is the proportion of the soap and water:—"*Eight parts water and one part soft-soap thoroughly amalgamated* form the lye which *takes* mineral oil, and thoroughly amalgamates with whatever proportion of this may be added,—that is to say, the paraffin may be put into the boiling soap and water in any quantity, and the whole will mix together of an equal strength throughout. Heat helps much in quickly producing thorough amalgamation of all the ingredients, and hence I have stated that they should be mixed in a *boiling state*."—(M. D.)

In my own use of this recipe I did not mix the paraffin in whilst the soft-soap was absolutely *boiling*, for fear of danger of the mineral oil igniting over the fire; but as my own work was on the small scale of garden-work, I followed the plan of Mr. Dunn's method of mixing, only using the word "hot" for "boiling":—"In practice I boil the proper proportions of soap and water together, and when ready I fill this into ordinary wine-bottles, which have been placed in boiling water. The bottles are about half-filled with the lye, and then the paraffin is poured into them, *two gills* being put into each bottle. The bottles are then filled up with the boiling lye, corked at once, and stored away for use.

"When required for use a bottle of the mixture is poured into a four-gallon watering-pot, which is filled up with soft water, and is ready for use, at a strength of one wine-glass of paraffin (*half a gill*) to one gallon of water."—(M. D.)

For field use the mixture would of course be prepared, and diluted to requisite strength on a large scale, but where needed for garden use there is a convenience in having a store at hand in small quantities of a definite amount and strength of fluid, so that all that need be attended to previous to appli-

cation is to be sure that no more than the prescribed quantity of fluid is added to a certain quantity of water.

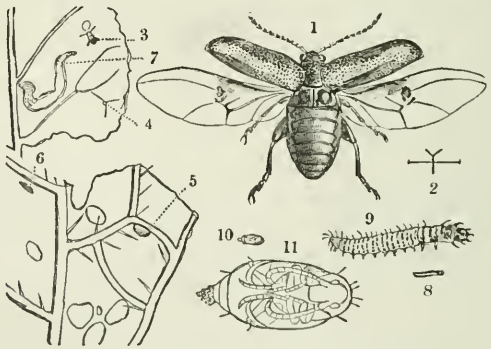
Some good may be done by copious syringings with such applications as ammoniacal water, tobacco-water, and soft-soap, the strength of the application being proportioned to what the leafage will bear. One part of gas-water or ammoniacal liquor to ten or twelve of water will kill Green Fly, but the strength of the liquor varies so much that experiment is necessary before use to ascertain its power.

Aphides multiply most quickly in dry weather, and on plants which are sickly from drought, exhaustion by insect-attack, or other causes; so that all measures of cultivation tending to produce vigorous healthy growth are serviceable in counteracting attack; and where circumstances allow of the application of liquid manure, or of water to an extent to make the plant-food in the soil available, and push on growth that otherwise was being checked by drought, such treatment would be desirable.

Where new growth is not being made, and the juices are being constantly abstracted by the Green Fly, the plant necessarily fails, unless extra food is supplied to start it forward.

Various kinds of Titmice, and especially the Blue Tit, are of service in destroying Aphides; and the common Ladybird Beetles and their larvæ feed on them voraciously.

Turnip Fly, or **Flea Beetle.** *Haltica* (*Phyllotreta*) *nemorum*, Linn.



1—3, *H. nemorum*: 4 and 5, eggs; 6—9, maggot; 10 and 11, pupa; all nat. size and magnified.

This is one of our most destructive kinds of insect attack to Turnips and allied crops.

The *P. nemorum* (figured above, magnified, in the act of

flight) is the kind more especially known as the Turnip Fly, or Flea Beetle. This is from a twelfth to an eighth of an inch in length, oblong-ovate in shape, black or greenish black, shining and punctured; the wing-cases have a distinct broad ochre- or sulphur-yellow streak running down the middle almost to the tips, where it bends slightly inward; the horns are eleven-jointed and black, excepting the three joints nearest the head, which are some shade of yellow; the thighs pitchy, shanks red-yellow, feet red-yellow or testaceous, or tipped with pitch-colour. But with regard to its appearance little description is needed for general use; we all know the small blackish shiny beetles to be found in myriads, in fine sunny weather, gnawing holes in the Turnip-leaves as long as they are undisturbed, but skipping off as briskly as the fleas from which they take one of their names, on being meddled with.

Besides the above kind there is the *P. undulata*, much resembling it but slightly smaller; the *P. concinna*, which is brassy, with a tooth on the second and hinder pairs of legs; another kind is black, and dark blue above; another is of a brighter blue above; but these are (as far as we know) alike in their method of living, in the harm they do, and the way in which they do it. The same methods of prevention or cure apply alike to all; it is almost impossible to distinguish them unless they are caught, and however much they may vary in marking, still in the point of view in which we are concerned with them here, they may all be classed together as Turnip Flea Beetles.

During winter the Turnip Flea Beetles may be found sheltered under bark, fallen leaves, clods of earth, and the like places; also amongst stubble, and especially in heaps of long strawy manure left on the fields; and on particularly fine days they may be seen coming out to sun themselves.

On the return of spring warmth they begin work, and, till the crops are ready for them, are especially to be found on weeds of the same family as the Turnip and Cabbage, such as Charlock, Shepherd's Purse, and Jack-by-the-Hedge.

When the attack begins on the Turnip the female lays her eggs, which are few in number, for successive days on the under side of the rough leaf. The maggots, which hatch from these in ten days, are white or yellowish, fleshy, and cylindrical; with three pairs of feet in front, and a sucker-foot at the end of the tail. The head is furnished with cutting jaws, and has large dark eyes. Directly they are hatched they gnaw through the lower skin into the pulp of the leaf, and make their way onwards, forming winding burrows inside it. Here they feed for about six days, then

they come out and bury themselves (keeping near the Turnip) not quite two inches deep in the ground, when they turn into the chrysalis stage, from which the "Turnip Fly" or "Flea Beetle" comes up in about fourteen days.

It is in this state that the so-called "Fly" does most mischief. It gnaws the seed-leaves, and the young plant when it first springs, and thus often totally destroys it; and also gnaws the rough leaves, forming large holes through the leaf.

There may be five or six broods in a season.

Much mischief is caused by Turnip Fly attack yearly, and especially in dry seasons; but in 1881, the year of the most general and severe attack, ever, as far as I am aware, recorded, the visitation of Turnip Fly was nothing less than a national calamity. The severity of the attack suggested that if, whilst the amount of injury was still fresh in the memory, those possessed of information would give details of the extent of the losses sustained, and of any means found practically of use, either in preventing or remedying attack, such information would be of great service to us all.

With this view, and with the valuable aid accorded me by the courtesy of Mr. J. Dent-Dent, President of the Royal Agricultural Society of England, Mr. C. Whitehead, Chairman of the Seeds and Plants Diseases Committee and now Agricultural Adviser to the Board of Agriculture, and other influential agriculturists, circulars were forwarded by myself to various localities throughout England and Scotland, and I was favoured with much valuable information in reply, both as to statistics of loss and measures lying in the common arrangements of good cultivation which were known to be of practical service in checking the evil. This information I published in a special Report entitled, 'Observations of attack of Turnip Fly in 1881,' and in the following pages I give some extracts, more especially bearing on the measures of cultivation found to press on the good growth needed to carry Turnip-plant in its first leafage past attack of the "Fly."

Taking first the observations sent of the extent of the Turnip Fly attack in England, it appeared that in the localities from which returns were sent in twenty-two of the English counties that re-sowing almost invariably took place to a greater or less extent once, in many cases twice, in some three times. The acreage under Turnips and Swedes in the twenty-two English counties reported on, was on the 4th of June, 1881, as stated in the agricultural returns of Great Britain, 1,149,768 acres; and from the reports sent to myself of amount of Turnip Fly infestation, it might fairly be presumed that it was generally present in the counties reported

from. If, however, we take half the total of 1,149,768 acres mentioned above, that is to say, 574,884 acres, as the area to be re-sown once in the counties under consideration (a calculation which is probably much below the real amount), we shall get a basis for an estimate.

1st. Taking loss on *seed alone* for one re-sowing; if we take the price of seed at 9*d.* per pound, and three pounds per acre as the quantity needed, this loss would amount to £64,674 9*s.* 0*d.*

2nd. Taking loss on one re-sowing of the same amount of acreage, including outlay for scuffling, harrowing, rolling, drilling seed, and possibly some additional superphosphate, we cannot well put the cost per acre under 15*s.* (if ploughing instead of scuffling should be required, it would be some shillings more, say 5*s.*); but taking the outlay as 15*s.*, this would amount to the sum of £431,163 on the 574,884 acres.

If, according to the estimate of some of our agriculturists, much better able to estimate outlay per acre than myself, this should be put at £1 rather than 15*s.*, the loss of course agrees in numbers of pounds with the acreage, £574,884 on 574,884 acres.

In Scotland Turnip Fly was present in various localities, or was generally prevalent to a serious extent in eleven counties.

The acreage under Turnips and Swedes in these eleven counties, as stated in the Government returns quoted above, was 194,105 acres.

Half of this total of 194,105 acres is 97,052, and, following the previous method of calculation, the loss on this would be for seed £10,918 7*s.*; for one re-sowing at 15*s.* per acre, £72,789; for one re-sowing at 20*s.* per acre, £97,052.

The loss therefore on the amount of acreage named in the twenty-two English and eleven Scottish counties would at the above estimate stand thus:—For seed alone, £75,592 16*s.*: for one re-sowing, including seed and cultivation at the rate of 15*s.* per acre, £503,952; the same at the rate of 20*s.* per acre, £671,936.

This amounts to just a little more (or considerably more) than half a million, if the larger rate of 20*s.* per acre is taken; but though the direct amount of money loss on unreturned outlay for seed and re-sowings in the districts known to have been attacked amounts to this enormous sum, and can at least be fairly well estimated, beyond this there is still a heavy loss to be considered on lesser value of the White Turnip than the Swede crop, and also on the deficiency of the late-sown crops, as well as in some cases the total loss. Also the deficiency of crop affects other points of agricultural supply, as want of cattle-food, and consequent lesser

supply of manure, depreciation of price of stock, &c.; so that it is almost impossible to say how far the loss extends.

The names of counties infested, and other details by which to work out the calculations, are given in my Report above referred to, but I give the abstract now as an example of how, under circumstances favourable to its development, one of our commonest crop infestations may, by its unproductive outlay, and the losses following in its train, become in the fullest sense a NATIONAL CALAMITY.

PREVENTION AND REMEDIES.—Some of the points that need particular attention are 1st, clearing off such weeds as the fly feeds on till the Turnips are ready for it; 2nd, such a method of cultivation and manuring as shall give a fine, deep, clean, and moist seed-bed, rich in available plant-food, so that a healthy and rapid growth may be promoted, and all points of shelter or harbourage for the "Fly" be reduced to the lowest limit; and 3rd, applications and special treatment to destroy the fly when it is badly infesting a crop.

With regard to weeds:—The fly frequents wild plants of the Cabbage tribe, as Shepherd's Purse, Jack-by-the-Hedge, and is especially fond of Charlock. It has been observed as unusually numerous where this weed has been plentiful in the previous year, and also to spread (as from a centre) to the neighbouring crops from a Charlock-infested field. It is often supported in the spring by these or other weeds till the Turnips are large enough for it to attack, and therefore means should be taken to get rid of them beforehand from the autumn stubbles. In the case of Charlock a double turn of the harrow over the stubble is of use; small weeds may be cleared by broad-sharing; the seeds are thus covered sufficiently to induce immediate germination, and the sprouting weeds as well as roots in the soil will be cleaned by the regular processes of cultivation further on. Waste spots of land and hedge-sides should also be attended to; the first is often overrun with Shepherd's Purse; the second is often infested with the tall, large-leaved, onion-like smelling plant with white flowers the shape of the Charlock-blossom, known as "Jack-by-the-Hedge."

The methods of cultivation recorded as successful in ordinary years, or in helping to bring a fair amount at least of the plants through attack in bad seasons, will be found to be based on knowledge of the *wants* of the Turnip-plant and the *habits* of the Turnip Fly.

The Turnip is very succulent, and needs plenty of food and moisture, and moderate warmth to press on growth; and the attacks of the Turnip Fly are most serious in heat and drought,

for in such weather the "Fly" or "Flea" Beetles propagate more freely, and use their wings, and consequently spread further; also heat and drought together keep back the growth of the plants, which are therefore exposed for a longer time to fly-ravage. Frost, or cold with drought, or cold with rain, or any kind of weather or circumstances that are unfavourable to plant-growth, also throw the crop under the power of this pest; but heat and drought are the worst, because they are good for the fly as well as bad for the plant.

In many of the following notes it will be observed that it is advised, by autumn cultivation (where this is practicable), or by working the land as early in spring as it can be done, to preserve the moisture that has accumulated during the winter for the benefit of the germinating plants. By thus preparing the soil beforehand, little stirring of the ground is needed when the time comes for seed-sowing; and, instead of the land being repeatedly thrown open to (what is often at sowing-time) a drying sun and air until the surface moisture is completely dried out, the application of the use of cultivators or scarifiers, which expose little fresh soil, is enough. The surface of the ground, which has been mellowed by exposure to frost, or weather influences, gives a fine tilth suitable for germination, retains moisture evenly, and gives it out gradually and genially for plant-growth. The most favourable conditions are thus secured for the germinating crop, and there is the further advantage that where the land has thus been well cleaned and cultivated beforehand there will have been all the less food and shelter for the fly in winter and spring, and consequently less risk of attack.

Methods of cultivation found most suitable for pushing on healthy, rapid growth of the plant, and so carrying it from under power of the fly.—"It is well known that want of moisture is the great promoting cause of injury by the fly. Next to this is a rough, badly-prepared soil in poor manurial condition.

"Autumn cultivation should be aimed at as much as possible. Land intended for Turnips should not require any ploughing in spring, and as little scarifying as possible. A few hundredweights of good artificial manure, applied either before or when the seed is sown, promotes a strong and rapid growth of the braird until it gets into rough leaf, when danger from the "Fly" is over.

"After a long experience I never saw a failure of a braird of Turnips on land which had been long and well-prepared before the seed was sown. Good seed and plenty of it, three pounds per acre, drilled deeply from (say) two to three inches, ensures a good start, even in the driest times.

"The application of soot, lime, nitrate of soda, or guano,

does much to save a crop (although much bitten by the fly) when a suitable rain follows, or when the land has been well moistened by a previous rain. Rapid growth is of course the great aim under any varying circumstances."—(Robert Vallentine, Burcott Farm, Leighton Buzzard.)

"A finely comminuted soil is of the greatest importance. On strong land autumn cultivation is essential; such soils, when ploughed immediately before sowing, invariably work cloddy. At this season evaporation proceeds rapidly, and the moisture is soon dissipated; hence vegetation takes place slowly and unevenly, and the young plants are eaten off as they appear.

"When the land is manured and receives a deep furrow during dry weather in autumn, the ameliorating effects of the winter's rain and frost reduce the surface to a fine tilth, and a shallow scuffling, to destroy the growth of annual weeds before sowing, preserves the moisture, insuring a rapid growth of the young plants.

"On the best Turnip land of the Midland Counties we prefer the ridge system of cultivation. The land, when reduced to a fine tilth, is ridged, the farmyard and artificial are applied, and at once covered in, and the seed immediately sown, whilst the soil is still fresh, on ridges twenty-seven inches apart. We never use less than three pounds of seed; we have always found thick seeding a great preventive against the inroads of the fly. Even when large quantities of farmyard manure are available we prefer an addition of two to three hundredweight of artificial manures per acre, which rapidly pushes the plant through the time of its first leaves, or cotyledonous stage. In the chalks and drier climate of the south we prefer sowing on the flat; here we have found the water-drill of great use in giving the young plants a speedy start in trying seasons. Great injury is often done by rolling the land before the surface is quite dry, and thus forming a crust, through which the young plants have great difficulty in forcing their way. In short, a fine tilth, plenty of seed sown at once before the moisture has time to evaporate, the land lightly rolled, and the use of a fair quantity of phosphate manures, are, in our experience, the best antidotes against the attacks of the Turnip Fly."—(Gilbert Murray, Estate Office, Elvaston Castle, Derby.)

"The Turnip Fly seldom attacks Turnips and the like severely enough to destroy them when they are sown on a "stale" fallow (that is, on land ploughed in the autumn and laid as fallow during the winter and spring following), free from weeds and in a friable state, and are drilled in with superphosphate."—(Thos. H. Baker, Mere, Wilts.)

"As far as my experience goes, the fly does not go on stale mould as badly as on freshly turned-up soil, and is not very troublesome if the wintered or frosted mould is kept for the seed-bed. I have known the fly begin on one side of the field and spread rapidly over it, but I have never known them in anything like this quantity on stale ground (or what may be called Nature's seed-bed). Where land has to be cleaned in the spring, and large breadths grown, small remedies are unavailing."—(Clement Cadle, Gloucester.)

The importance of a good fine tilth is especially and repeatedly dwelt on, as in the following note,—one of many observations on this head:—

"A fine tilth is most desirable; the parts of a field first hopelessly injured are those where the surface is the roughest, the small clods causing the moisture to dry out more quickly, and affording shelter for the fly from breezes which they do not like. All the preventives I have seen applied either to the seed or to the crop when attacked have been total failures."—(Thos. Hopkins, Limber Grange, Ulceby.)

But advice is also strongly given that the requisite tilth or fineness of the soil should be brought about by measures such as those advised above, which will leave the proper amount of moisture still in the soil "without having to knock it about too much in a dry hot time."

Thick sowing, from three up in some cases to five or even nine pounds per acre, is advised or mentioned as successful by various growers, who state that thus, in case of hot dry weather, the plants will thrive better for the protection they give to each other (being thus moderately damp, with the roots shaded), and that some may be reckoned on to escape the fly. This, however, needs careful looking to, or the result will only be a worthless drawn growth.

The importance of a good start to the plant cannot be overrated, and the effect of a plentiful supply of moisture in helping early growth forward is undoubted. In ordinary conditions, however, it must be the preceding cultivation and treatment of the ground which must be trusted to for this. The following notes give suggestions of what may be done where circumstances permit.

"Anything that would *accelerate vegetation* would be the best means of saving the crop, but the reason the fly is so destructive on bright hot days is because half-a-dozen bites on the first smooth leaves of the Turnip-plant wound them so much that the scorching rays of the sun shrivel the plant quickly and completely; whereas, if the days were cool and cloudy, the plant might survive long enough to enable it to

throw out the rough leaves, which the fly will not attack so freely."—(Thos. Hopkins, Ulceby.)

"In moist weather the flea is comparatively harmless; it is when dry parching weather sets in, just as the Turnips break ground, that the attack is most to be dreaded. In such cases I am of opinion that a frequent use of the *water-cart* is the best thing to do."—(Watson Hornsby, Holme Cultram, Cumberland.)

With regard to precise effect of watering on the germinating plant, I can state, from such experiment as I have been able to make, that at the end of a fortnight from their appearance above ground, the plants from a patch of Turnips which had been watered (in a season of drought) on either two or three evenings, *weighed one quarter* or rather more than the plants from precisely the same measure of ground close by, and in exactly the same circumstances, excepting that they had not been watered.—(Ed.)

"As to the effect of sowing in dry seasons with the *water-drill*, I have always found the water-drill most successful in moist seasons. *When the land is very dry, the amount of water put in by a water-drill is not sufficient to be of any service to the Turnip-plant, and sometimes it is sufficient to cause the seed to germinate, and then, if rain does not come, it dries up or malts in the land.** I have always, in a general way, found the water-drill starts the Turnips much quicker than the dry-drill, and they generally are fit to single out a week earlier than if sown by dry-drill."—(Thos. H. Baker, Mere, Wilts.)

The following notes refer more particularly to desirableness of sowing before the surface of the soil has dried after cultivation.

"In the neighbourhood of Ardkinglas, Inverary, only one field is noted to have escaped ravage of Turnip Fly for miles round. This one field was a stubble, and in a damp locality lying along the banks of the River Fyne, with high-lying fields opposite. It was not ploughed till shortly before sowing, a fine and *moderately damp mould* was turned up, the seed was *immediately sown*, and a fine braird and crop followed. Several instances of re-sowing proved abortive, but wherever the drills were well harrowed down and set up by the common single-plough fewer failures occurred."—(Thos. Wilkie, Cairndow, Argyllshire.)

"I think that *surface moisture* is a good preventive, and that the seed ought to be sown *as soon after the ground is prepared* for its reception as can be, and the land not allowed to get dried."—(Thos. Brunton, Thame Park, Oxfordshire.)

* This point appears of so much importance that I have drawn attention to it by italics.—Ed.

Various methods of disturbing or driving away the fly, by rolling, sheep-driving, application of dressings, &c.: the point of many of these applications being made when the dew is on *is very important, not only because under these circumstances the dressings adhere to the leaves, but also when the Fly or Flea Beetle has its limbs clogged by moisture it cannot use its hind legs for its long flea-like jumps; consequently, much larger numbers of fly remain in reach of the dressings.*

Rolling.—"A process which has been practised with marked success by various farmers in the neighbourhood of Ilminster is, when the plants have got their second leaf, and the fly has made its appearance, to *roll them* with a heavy horse-roller *between one and two o'clock of a summer's morning*, when it is just light enough to see where to go. In some cases the process has to be repeated at a fortnight's interval, but usually one rolling is enough."—(Rev. G. T. Blomfield, Norton Rectory, Ilminster.)

"It is my invariable practice, when I see the plants attacked, at once to run a *light roll* over them. The operation is not pleasant to these troublesome insects."—(Charles Howard, Biddenham, Beds.)

"*Rolling* often saves a piece of Turnips; it dusts the young plants, and 'firms' the soil to the injury of the fly, but to the benefit of the Turnips."—(W. J. Edmonds, Lechlade.)

Driving Sheep.—"From observations I found that the fly does not feed freely on dusty plants; so I have been in the habit of *driving a flock of sheep* over the field as soon as the plants appear. This I found very beneficial, as, if done *early in the morning*, when there is a *little dew* on the young leaves, the fine dust adheres to them, and the fly will not feed on them until they have been washed. This remedy will not act in rainy weather, but neither does the fly then work, or if it does the plant soon outgrows the injury. If the sheep are driven about on the land more than once they will do no harm, only a few plants will be disturbed. This remedy is a very simple one, and I have certainly found it efficacious."—(Jabez Turner, Norman Cross, Peterborough.)

Relatively to the same practice, I was favoured, in 1877, with the following communication:—

"The field of Turnips I *drove sheep* over was thirty-seven acres; number of sheep, 400 to 500. The fly, when I saw it at the end of June, was so strong as to threaten clearing the crop, and it had almost been decided to plough it up; but this treatment, which embodies disturbing and killing many of the insects by the treading, and which also makes the leaves distasteful for oviposition, both by rubbing of the sheep and the coat of dust scattered in dry weather, saved the

plants and was followed by a good crop. This is no new thing, as I have many times done so, and thereby saved the crop, which is in no way injured by the treading. The only injury is to the sheep, as they are not willing to be treated so, and require a dog to be used to keep them together, and at the same time make them take all the ground in turn. We drive the sheep over part of the field one day and part another, as it does sheep harm to keep them long without food, and also to drive them early in the day; and this should be done at *five in the morning, when the dew is on the leaf.*"—(R. P. Tanner, Ogbourne Maizey, Marlborough.)

Dry dressings of various kinds, as lime, soot, &c., have long been known to be of service in checking fly attack, if applied at the right time of day,—that is, when the fly was quiet in the morning or evening or in dull damp weather, rather than in sunshiny times, when either by its powerful leaping legs, or by expanding its large wings from under their horny wing-cases, the fly might at once remove itself from danger. Soot, lime, road-dust, and others of the usual applications have been found useful, and may all be serviceable if applied when the dew is on; but the remedy that appears the best proved is the one noted by Mr. Fisher Hobbs as having never failed during the eight years in which he made use of it. I give the recipe and passage at length from his statement made before the Council of the Royal Agricultural Society, quoted in the 'Gardeners' Chronicle and Agricultural Gazette' for May 28, 1859, p. 473:—

"One bushel of white gas-ashes" (gas-lime) "fresh from the gas-house, one bushel of fresh lime from the kiln, six pounds of sulphur, and ten pounds of soot, well mixed together and got to as fine a powder as possible, so that it may adhere to the young plant. The above is sufficient for two acres, when drilled at twenty-seven inches. It should be applied very early in the morning *when the dew is on the leaf*, a broadcast machine being the most expeditious mode of distributing it; or it may be sprinkled with the hand carefully over the rows. If the fly continues troublesome, the process should be repeated; by this means two hundred to two hundred and twenty acres of Turnips, Swedes and Rape have been grown on my farm annually for eight or nine years without a rod of ground losing plants. The above is a strong dressing to be used when the fly is very numerous, and has never failed when applied at night. Numerous experiments have been tried, and amongst them I recommend the following in ordinary cases. . . . Fourteen pounds of sulphur, one bushel of fresh lime, and two bushels of road-scrapings per acre, mixed together a few days before it is used, and

applied at night, either by means of a small drill or strewed along the rows by hand. I have known sulphur mixed with water applied in a liquid state by means of water-carts during the night, and the horse-hoe immediately following the water-cart. This has succeeded admirably."

Many kinds of dressings would do good, but until lately there has been a great need of some method of applying them over a larger area, more rapidly and far more completely than could be done at a paying rate by hand. This difficulty, as far as could be judged both by experiments (made before the public during 1888), and still more from practical trial, with regard to checking attack of Turnip Fly, appears to be quite met by the working of the implement properly known as Strawson's air-power distributor, or pneumatic drill, popularly known as the Strawsonizer.

By the action of this implement, dressings, whether wet or dry, can be dispersed in a mist-like form, of such fineness as to coat the leaves delicately and finely, but thoroughly, and much more effectually than with hand-dressings.

The following notes of successful work by means of this distributor, in stopping attack of Turnip Fly on badly-infested fields, were placed in my hands, at my request, respectively by Mr. W. George Mount, M.P., of Wasing Place, near Reading; and by Mr. Geo. Budd, of Mousefield Farm, near Newbury.

In the case of Mr. Mount's Turnips, the dressing was given about 3 a.m., or earlier, in the morning, and at my request he gave me result as follows:—"I sowed some Swedes on nine acres of land in May last year. Early in June the 'Fly' was strongly upon them. I obtained the use of Mr. Strawson's machine, and dressed part of four acres with lime, part with paraffin; both remedies seemed to be equally efficacious, and I shall certainly use it again this year, if necessary."

At Mr. Budd's farm the dressing was applied in the evening, and was as above, of paraffin oil, or of this mixed with lime, the "Fly" attack being very bad at the time. Of this Mr. Budd wrote me that he found great benefit from Strawson and Co.'s distributor, as where he had not used it he had to drill for Turnips again; it was a great prevention to the fly, and enabled him to feed off a very early crop.

When this implement is issued from the maker, there appears reason to hope that it will be of great service.

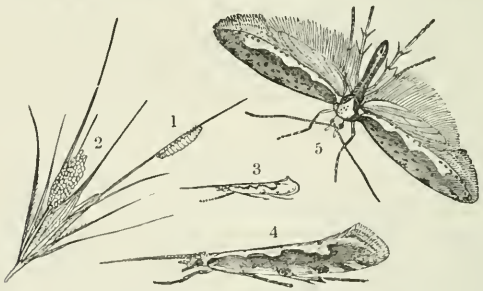
In the foregoing notes I have only given the more important parts of the communications placed in my hands in 1881, more particularly embracing the special points of lessening the amount of presence of, and injury from, Turnip Fly by

previous cultivation suited to push on growth of the plant,—treatment at time of sowing,—and measures of tried practical service for clearing the pest when on the plants. Other minor points of more or less service, such as mixtures of different ages or different kinds of seed,—the very doubtful benefit of steeps,—plans found in some cases of use for mechanically catching the fly, &c., space does not allow of insertion here.

Much of serviceable interest was also given, regarding extent and nature of attack and details of damage in the infested area; and I was particularly indebted to Mr. J. H. Arkwright, of Hampton Court, Leominster, for the valuable mass of information which he placed in my hands, containing details of methods of cultivation, amount of attack, and means of prevention and remedy used in Herefordshire, and more especially from parishes lying in a district of a radius of seven miles round Leominster; much also was given me by many other valued contributors, to all of whom I still feel my sincere acknowledgments to be especially due, as forming my Turnip Fly Report was one of my first pieces of public work, and the usefulness was entirely owing to the widespread and skilled contributions and co-operation so kindly granted me.—Ed.

Diamond-back Moth.

Plutella cruciferarum, Zell.; *Cerostoma xylostella*, Curtis.



1, caterpillar; 2, eggs; 3—5, Diamond-back Moth, nat. size and mag.

The appearance of the Diamond-back Moth caterpillar on the Turnip crops has only been recorded (with us) now and then, but when it does happen it is often very destructive. The caterpillars feed voraciously, in bad attack clearing away the substance of the leaves down to the ribs, and sometimes gnawing away these also.

In 1851 this caterpillar is recorded as having appeared in

enormous numbers both in England and Ireland, in some instances almost clearing away the attacked crop. In 1883 and 1884, I had observations of them as being mischievous to leafage of White and Swede Turnip, Rape and Kohl Rabi, and from 1884 I had no further reports of the presence of the infestation until the autumn of 1889. The localities from which specimens were sent were chiefly various parts of Yorkshire, likewise from Aberdeenshire, and in 1889 from near Henfield in Sussex.

The attack is very widely distributed; it is said to occur over all Europe, and I have had specimens from Cape Colony.

The caterpillars are about half an inch long, spindle-shaped (that is somewhat tapering to the head and tail), and sixteen-footed. Colour a delicate green, head yellow or grey (or, as described by one continental observer, black), segment next to the head marked with minute black dots, and the two succeeding segments each marked with a small oval yellowish spot on either side of the middle line. The succeeding segments, as well as the first, with some minute black dots.

As many as two hundred and forty of these caterpillars have been counted on a single plant of moderate size. When full-fed they spin cocoons of fine net-like texture on the remains of their food-plants, or on the ground, from which the moth comes out in about three weeks or less, so that there may be a succession of generations during the summer. The autumn chrysalids remain unchanged during the winter. The caterpillars feed in heads of Cauliflower, and on unripe seeds of some plants of the Cabbage kind, as well as on leafage.

In the specimens observed, the light cocoon was left open at each end, so as to allow the chrysalis to leave its old caterpillar-skin outside at one extremity, and the moth on coming out of the chrysalis case to escape at the other.

The chrysalis is greyish white, with several black streaks down the back and sides. The moth, which soon hatches (in the summer), to the naked eye appears not unlike the Clothes Moth. When magnified it will be seen (as figured at p. 192) that the fore wings are long and narrow, greyish-brown, darker towards the centre, with a rather broad whitish band along the wing towards the hinder margin, this stripe being waved so that when the moth is at rest the two edges of the wings laid flat along the back form a row of pale diamond-shaped markings, whence the name of "Diamond-back Moth." The hinder wings are narrow, of a pale ashy grey colour, and have a long fringe. The spread of the wings is about two thirds of an inch. There appears to be a succession of broods, as the moth is observable from the end of June until October.

Prevention and Remedies.—Almost the only method of lessening amount of damage from presence of these caterpillars appears to be from natural or artificial applications suited to drive on growth.

On August 8th, in 1883, Mr. H. Stourton, of Holme Hall, near York, writing of a bad attack in the district, mentioned that he put on nitrate of soda and soot—and on the 21st of the same month, whether from favourable weather for growth having occurred, or from the use of the fertilisers, "some of the damage was being repaired."

In the South African observations, sent me by Mr. J. de Witt Meulen, of the Winterhoek, he noted, "heavy rains or frequent watering of the leaves destroys many grubs."

The best note of stopping attack by dressings was sent me by Mr. Henry Ross, from Chestham Park, Henfield, Sussex, in the autumn of 1889. The attacked Kale on the 30th of September was only about an inch high; I suggested Mr. Fisher Hobbs' dressing (see p. 190) *applied when the dew was on*, so that the dust should adhere to the leaves, but soot alone proved sufficient. Mr. Ross reported that he used soot lavishly (100 bushels per acre sowed broadcast):—We were fortunate in our weather—a humid morning, every leaf holding moisture, and the plants went off at a jump; and on the 13th of January the Kale was reported to have been growing ever since, and to look most kindly.

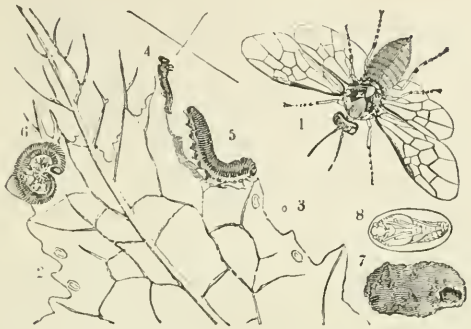
The plan of brushing the infested plants with boughs fixed on a scuffler has been found to answer in some cases. The Diamond-back caterpillars let themselves down by a thread when alarmed; consequently, by the passage of the scuffler after the boughs, many must get destroyed on the ground.

The caterpillar also feeds on other plants of the Cabbage Tribe, as the very common "Jack-by-the-Hedge," "Wall Mustard" and others; and where the cocoons are observed in great quantities on large weeds by field sides, it would be well to have the plants drawn or, where practicable, rough mowed and destroyed; also where, as sometimes happens, a crop is totally ruined, it would be well to plough it thoroughly in at once before the moths could develop out of their cocoons, and fly to cause attack on neighbouring Turnip or Cabbage fields.

Turnip Sawfly. *Athalia spinarum*, Fab.; *A. centifoliæ*, Panzer.

The caterpillars of this Sawfly, which are known under various names, as "Blacks," "Black Palmers," "Niggers," &c., appear from time to time in very large numbers, and do serious damage, sometimes clearing the leafage of a whole

field of Turnips, excepting such of the veins as are too hard to be eaten, in the course of a few days.



Athalia spinarum: caterpillars, pupa, and pupa-case. Sawfly, magnified, with lines showing nat. size.

Taking the dates of some attacks which are especially recorded, we find them noticed in 1756, 1760, 1782, 1806, 1818, 1833, 1835, and the following years up to 1838; in 1782 it was estimated that about two-thirds of the Turnip-ground in Norfolk had consequently to be ploughed and re-sown; but the worst attack recorded took place in the dry summer of 1835, when the injury to the Turnips extended as far north as Durham; and in the southern counties, from Somerset to Kent, the crop was a failure, the second and even the third sowing being devoured by these "Niggers."

The only occasion on which I have seen the attack myself—and then only as occurring to a slight extent—was on a Turnip field at the top of the cliffs above the Severn, at Sedbury Park, in W. Gloucestershire. This was in the autumn, and accompanied a high wind. From the state of the Sawflies on first observation it appeared as if they had been carried by the gale from fields lower down the Bristol Channel, and thrown, partly exhausted, on the crop at the first high level, and very slight presence of caterpillar followed. The worst instance of infestation (reported to myself) was in 1881 on some Turnips near Ashford, Kent. After coming into rough leaf, the black caterpillars attacked them and cleared them in a few days. The loss was estimated at about £7 per acre.

The Turnip Sawflies which produce these caterpillars are dull and torpid in moist and cloudy weather, but they thrive and fly actively in warmth and sunshine; and it is during the period when the sunshine is hottest that pairing takes place.

The eggs are laid one by one in small slits cut for them in the margin of the leaf by the saw-like ovipositor of the female

(from which apparatus the Sawflies are named); and the eggs are very numerous, one female laying from two to three hundred.

These eggs hatch in about five days, or less in warm weather, but take more than twice that time if the weather is damp and cold. The grubs begin to feed immediately on coming out of the eggs, and are at first nearly white, but soon become of a greenish white colour, with a black head; afterwards they become jet-black, with a paler stripe on each side, and whitish head; and when nearly full-grown they are slate-colour, with black head, and pale beneath, in addition to the pale stripe just mentioned. Before their first change of skin (or moult) they cling to the leaf, and, if disturbed, let themselves down by a thread and go back again up it at pleasure; afterwards they fall down, having no power to spin threads at this stage of growth, and remain awhile as if dead, and then crawl back again up the stems to the leaves.

Sawfly caterpillars destroying Turnip-leaf.*

These caterpillars have in all twenty-two feet, consisting of a pair of "true feet," horny, and furnished with claws on each of the three segments next the head; a pair of "sucker-feet" (fleshy cylindrical masses by which the caterpillar can hold

* The above characteristic figure of devastation by "Nigger" caterpillars is acknowledged with thanks as being from the 'Letters of Rusticus' (by the late Edw. Newman).

fast at pleasure) on each of the succeeding eight segments, excepting the fourth from the head, and another pair of sucker-feet at the end of the tail—thus having only one segment besides the head unfurnished with feet. They greatly enjoy being exposed to the full heat of the sun. When full grown, which is in about three weeks, the caterpillars are from about half to three-quarters of an inch in length; they then go down into the earth, spin a silken cocoon, which is smooth and white inside, but not easily distinguishable from the earth, which sticks to it externally; and from these cocoons the Sawflies come out in about three weeks in the early summer, and are ready to lay eggs and start a new attack immediately. Later in the season, three months pass before the caterpillars turn to chrysalids, and many of the autumn brood are believed to remain in the cocoons during the winter, and not to change to chrysalids (and thence to Sawflies) till the next spring.

These flies are very pretty, of a bright orange, with a deeper reddish colour just behind the black head; the four transparent wings are netted over with veins, and are yellowish towards the base; the legs are stout and short, with the shanks hairy; and the feet are whitish, with the tips of the joints and all of the lowest joint, as well as the claws on it, black.

The mischief caused by these flies when they occur in large numbers is simply overwhelming, and often (in such cases) only ceases with the total destruction of the crop, in consequence of the voracious appetites of the grubs and the rapid succession of broods.*

The Sawfly caterpillar feeds on Charlock, Wild Mustard, and other wild plants of the Cabbage tribe.

Prevention and Remedies.—The best of these are to be found by looking at the habits of the grubs.

If these grubs or caterpillars are disturbed whilst they are changing their skins, which happens every six or seven days during the three weeks in which they continue feeding in grub form, they die; for if they loose hold with the pair of feet at the tip of the tail during this operation they cannot fix them again; consequently they have nothing they can pull against to drag themselves out of the old tight skin, and therefore

* For further details of the enormous quantities in which they have been recorded as appearing in various places, the swarms in which they pass from one spot to another, and much valuable information too long to be entered on here, the reader is referred to the account (from which the above note is abridged) given by John Curtis in his 'Farm Insects.' Much information will also be found regarding this attack in 'Mon. of Brit. Phytophagous Hymenoptera,' by Peter Cameron, pp. 307—313.

they perish in it. Also—as mentioned above—if alarmed, they drop from the leaf, and after the first few days they have no power of spinning a thread; consequently, have some difficulty in getting back again.

Looking at these points, it has been found useful to dislodge the grubs by sweeping the Turnip-leaves with boughs of light leafage or twigs, such as Fir, Furze, or Broom.

Many different ways are noted: such as fastening the boughs on a cart-rope, held by a man at each end, which thus may be dragged along so as to brush the Turnips; or fixing them to a bar supported by two wheels so that the boughs may lightly sweep the leaves as they pass over them; or again, fixing a good-sized Fir-branch or bunch of Broom in front of a scuffler, and thus, whilst the blades do their regular work, the branches sweep down the grubs, many of which are killed or do not come up again.

It is also found serviceable to drive sheep through an infested field. The passage of the sheep disturbs the caterpillars, many of which fall from the leaves and are trodden under foot.

Mr. Hart, of Park Farm, Kingsnorth, Ashford, Kent, reported, in 1880, that in August he had "used sheep and lambs with good effect in an attack of 'Niggers' on Turnips." About a hundred of them were driven backwards and forwards for an hour three days in succession, which *quite cleared the plants*, and did no harm to the animals. The attack was noted by Mr. Hart as the only one of the kind which he ever had to deal with, and he tried several other kinds of treatment before resorting to the droving, but they were all useless, and there is the special advantage, with regard to droving, that many of the grubs are trampled to death by the sheep; but any measures that will make the grubs fall down are serviceable.

Any treatment which may give a temporary check to the plant whilst attack is on is particularly to be avoided, therefore singling and hoeing at such times are in no way desirable.

Thick sowing is of advantage against the Sawfly, as well as against the Turnip Flea Beetle, both for the reason that some part of the crop has a chance of escaping and also because the Sawfly likes sunshine and dryness. Where the leaves are plentiful there is more moisture and shade, and these parts are safer from attack; and also in the hot dry seasons in which these Sawflies thrive the thicker vegetation will help on the plant, which loves moisture.

Drenchings of liquid manure, or fluid stimulating dressing of any kind preferred, distributed with as much force as was safe for the leafage by the Strawsonizer might be expected to be very beneficial. These would stimulate the growth of the

plant, and destroy many of the caterpillars by washing them off the leaves into the wet soil.

In all attacks on leafage it is of the utmost importance to keep up the strength of the plant; the damage done is by the grubs destroying what for its own vegetable uses are in fact its breathing and digestive organs. It cannot live without its leaves, and if a larger portion of these are eaten off each day than is replaced by growth, it fails just in that proportion. By the application in moist weather of nitrogenous or ammoniacal manure, or by watering with liquid manure in drought, a plentiful supply of food is brought to bear at once, and thus we may possibly tide the plants over the difficulty and save the crop within the bounds of remunerative outlay.

Where a Turnip field has been infested during autumn, it is desirable to work the surface with a scarifier or grubber so as to turn up the earth cocoons with their contents to the surface, where a good proportion of them would be destroyed.

Surface Caterpillars: Caterpillars of the **Turnip** or **Dart Moth,** *Agrotis segetum*, Ochsenheimer; also of the **Heart-and-Dart Moth,** *Agrotis exclamationis*, Linn.

Common Dart Moth; 1, moth; 2, caterpillar.

The term of "Surface Caterpillars" is applied to various kinds of moth-caterpillars or grubs, which, like the so-called "Turnip-grub," the caterpillar of the Turnip or Dart Moth, live and feed near the surface of the ground. There are many kinds, but those of the Dart and the Heart-and-Dart Moth, resemble each other so much, both in their appearance and habits, that they may conveniently be placed under one heading.

They do an enormous amount of damage, especially to Turnips; but the amount of prevalence of the infestation is

variable. In 1884 and 1885, respectively, they were at work in February and March, and were excessively injurious later in the year. In 1885 the main brunt of attack was reported during August, and observations sent of severe infestation of these Surface Caterpillars at localities in Somersetshire, Surrey, Worcestershire, Oxon, Salop, Lincolnshire, Wilts, Gloucestershire, and from Co. Cork, Ireland; also before or after from Kent, Essex, Berks, and Staffordshire, together with notes of damage done to Swedes and White Turnips, Cabbage plants (including seedlings just germinating, winter Beans, Potatoes, Oats, &c.); and in the same year Mr. W. W. Glenny, of Barking, an excellently qualified observer, reported:—

"In the autumn surface grubs were plentiful after the dry summer, and greedily devoured food of a varied character. It was difficult to escape these omnivorous insects, for no field and no crop was free from their inroads. Amongst transplanted Leeks and Cabbage they did most harm, yet they equally bit off, just near the top of the soil, Turnips, Spinach, Onions, Beetroot, Carrots, Lettuce, &c. Instead of describing which plant they prefer, it would be easier to say that there is no vegetable or herb they refuse.

"The late Potatoes were damaged by them, and a fair piece of Magnum Bonums was attacked in such a manner that, though it would have been convenient to have allowed the crop to mature and ripen in the field, it was absolutely necessary to dig the produce to prevent the grubs eating them all."

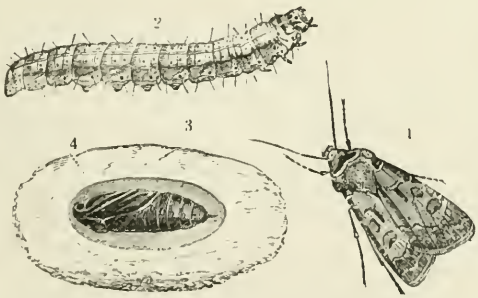
Taking the history of the Turnip Moth first:—The egg is laid during the summer, as early as June or towards autumn, and the caterpillars hatch in about a fortnight. These, when full-grown, are about an inch or an inch and a half long, nearly as thick as a goose-quill, and smooth, with a few hairs; of a pale smoky colour, but sometimes pinkish, or purplish brown, and with two dark lines along the back and one along each side; these lines, however, are not always distinct. The head is horny, much narrower than the next ring, and is stretched out on a plane with the body; it is of a pale dingy brown with black jaws; ochreous eyes dotted with black, and a cross-like mark on the face. The first ring brown, divided by three pale lines; on the other segments are four black dots (placed obliquely, two on each side of the central line), and three black dots at the base of the thighs.

When first hatched, the caterpillars appear to feed chiefly above ground, choosing the part of the plant just at the surface of the earth (between the root and stem), and, thus gnawing off the tops, they destroy the crop to a serious extent;

as they grow stronger they go further down, and generally remain wholly underground or only come up at night to feed. Whilst the plants are young the caterpillars feed on those near them, going on to others as food gets short, gnawing off the tops as above mentioned, or feeding on the leaves, which, after having cut through the leaf-stalks, they drag partly down into their burrows, to be eaten during the day. When the Turnips are formed, the caterpillars establish themselves inside the bulbs, and as many as twelve may be found in one Turnip; these gnaw large holes and cavities, sometimes going completely through from one side to the other, and continue to feed there till the bulb is consumed, or till they have to leave it on account of frost or some other cause.

According to circumstances of climate, &c., they feed during the winter, or pass it in cells formed in the earth, coming out to feed again in the early spring. In May or June they turn to smooth brown chrysalids in the ground, from which the moth appears in about a month.

This moth has the fore wings of a pale grey ground-colour in the male, dark umber-brown in the female, with various markings, as figured; the hind wings are pearly white, clouded towards the hinder edge in the female, and with dark rays. The colour of the body (including the abdomen) varies, like the ground colour of the fore wings, with the sex: it is lighter in the males than in the females.



Heart and Dart Moth, caterpillar, and chrysalis in earth-cell.

The habits of the Heart and Dart Moth are similar to those of the preceding kind.

This caterpillar is about an inch and a half long when full grown, of a dull lilac colour, with a paler and more ochreous stripe down the back, having one indistinct dark line along each edge, and a double one along the centre of the back. Beneath it is whitish green; the head is brown, with black jaws, and the first ring of the body behind the head is horny

and brown above, with darker spots; all the other rings have four little tubercles on the back of each, and several on the sides, each tubercle having a short hair growing out of it. The caterpillar has three pairs of claw-feet, four pairs of sucker-feet, and one pair at the end of the tail; it is flattish and has little power of holding on with its feet, so that it readily falls when the plant is shaken. When full-fed it forms a cell in the earth in which it changes to a rust-coloured chrysalis, from which the moth comes out in June of the following year, or sometimes a little earlier.

The moth is of a clay colour, marked as figured above; the spot behind the head is black; the upper wings are dark towards the front edge; the under wings in the male are white, with the upper margin and nerves brownish; in the female the under wings are dark brown.*

The "Surface Caterpillars" lie concealed during the day, rolled up under the root-leaves of the food-plant, or beneath clods or stones, or beneath the surface of the earth, or in any available rubbish. They come out in the evening and feed during the night, passing from one plant to another and gnawing the leaves off at the crown, so as to do far more mischief than those that only eat straightforwards at one spot.

On the Continent these surface caterpillars, besides their ravages on root and other crops as mentioned above, are particularly hurtful to roots of Grass or Wheat, or Corn generally,—so much so that the kind known with us as the "Turnip Moth" is there known as the "Winter Corn Moth."

Prevention and Remedies.—These are most difficult to find, for the presence of the caterpillars is only known of by the mischief which they have done, and it appears almost impossible to injure them by waterings or fluid dressings, as the poison soon loses its power in sinking through the earth, and also the grub can move away from the disagreeable application.

In August of 1885, Lt.-Col. G. Coussmaker, of Westwood, Guildford, whose Swedes were then severely infested by surface caterpillars, at my suggestion tried the effect of soft-soap and kerosine on these Dart or Turnip Moth caterpillars, and reported thereon as follows:—

* The above descriptions of the two kinds of surface caterpillars and their respective moths are almost entirely taken from Curtis's 'Farm Insects'; but practically, from differences of condition, age, and food, it is very difficult to distinguish certainly between them; and it may be also observed that when, for want of vegetable food, one (as is not unusual in captivity) eats another, I have found the appearance of the eater remarkably thriving, but at the same time I have never found that the eater of his brethren was attacked by the survivors.—Ed.

"I have tried the soft-soap and kerosine on the Dart Moth caterpillar, and found that when it touched them it killed them. I put some on to a clear piece of ground, poured a little on them, covered them over with earth, and in a couple of hours uncovered them: they were dead. Others I put in a similar place, covered them over with earth, and watered them with the preparation, but it had not soaked through enough, and they were none the worse.

"I also poured some round several plants. In a very few cases the grubs had worked up, and were lying dead, but in the majority of cases it had not affected them. The experiment was further tried by sending a worker with the mixture in a pail, with instructions to give a small quantity to each plant, but the result showed that the plan would not work for field use.

"As the caterpillars do not always lie close to the roots, I found that the application of soft-soap and kerosine oil was not of much use. Those which it touched did die certainly, but when we began to scrape away the earth we found many, several inches away, quite unaffected."

Dry applications such as quicklime, put directly on the caterpillars, also direct applications of soot, sulphur, and salt, failed to have any injurious effect at all on them; but still, in the case of soot at least, this would do good by encouraging the growth when only a part of the roots had been hurt, and it would be very likely to keep the caterpillar from coming up through it to attack the plant. Where Cabbages have been attacked by surface caterpillars, the treatment of applying a handful of soot round the stem of each of the plants and earthing them up immediately has saved the crop, and been followed by a good growth.

In the case of salt also, although it did not kill the grub as a direct application, yet amongst several reports on surface caterpillar-presence, sent me from the north of Suffolk in 1884, the following occurred:—

"Sowed a considerable quantity of salt and then applied farmyard manure to a piece of land, and after ploughing in sowed White Turnips: this was on light land. Result,—a first-rate crop."

In this case the date of application might have something to do with success (a crop sown after a heavy farmyard manuring alone was a total failure); but if it chanced the salt above-mentioned was given just when the caterpillars were making their cells, and consequently unable to escape from its influence, this might account for the serviceableness.

Gas-lime in contact with the grubs was found to kill them, and another observer noted, "They do not like gas-lime." It

has been found to answer in keeping off attack, and on the small scale of garden cultivation, when put by hand in a narrow ring round the stem of an infested plant, has been found to do good. The amount that is safe would vary with the age of the plant and time of exposure of the gas-lime to the air, but in the case of half-grown kale and gas-lime about two months from the works, a ring about as thick as a finger round (but not against the stem) is quite safe.

The mixture of gas-lime, &c., found serviceable by Mr. Fisher Hobbs as a remedy for Turnip Fly (see p. 190), would also be worth trying as a remedy for the "Surface Caterpillars."

At present, as far as I am aware, though it seems likely that various applications *might* do more or less good, there is no certainty about results, and the only two methods of treatment which can reasonably be trusted to, to lessen amount of grub-presence, are thorough disturbance of the surface soil, or hand-picking.

With regard to hand-picking, this remedy is largely practised in the Cabbage-growing district round Hounslow. Workers are sent along the rows, with a blunt knife or pointed bit of wood in one hand, and a flower-pot or any convenient vessel in the other. The grub is turned out with the stick or knife and put in the flower-pot, and thus much more rapidly than might be supposed the field is cleared. The plan is undoubtedly tedious and expensive, but thus the grubs *are* got rid of. If not removed the grubs will almost certainly go on and injure or destroy another or more plants the following night, and continue so doing; so that the work of removal will probably pay, where the state of the crop will allow of the plan being carried out.

In 1886 Mr. J. Craig (Bradford Estate Office), Weston-under-Lizard, Shropshire, wrote regarding hand-picking:—

"I had large numbers of the grubs picked from the roots of my Turnips last year, after hearing from you, and thus, I think, saved a good portion of the crop." And in a special observation sent by Col. Coussmaker before quoted, he reported sixteen quarts of the grubs picked from seven acres.

Relatively to disturbance of the surface as a means of getting rid of this grub, Mr. Colbauen, writing to me from Woolhampton, near Reading, on the 23rd of Aug., 1886, remarked:—

"I have battled with this enemy for many years, and have treated it with all sorts of dressings, but never found anything so effective on a large scale as the free use of the drags and harrows, especially amongst young roots. I have this year over 100 acres of good Swedes, Turnips, and Mangolds, only saved by the free use of the harrow. This brings

the grub to the surface so that the Rooks and Starlings can pick them up. I fancy Rooks do not care much for them, if they can get other food; but Starlings seem very fond of them. I have a small patch of Mangold planted on the ridge which we could not harrow, and, as it may be interesting to you to see how the bulbs have been injured by this creature, I have forwarded a specimen root, together with two of the caterpillars."

Well stirring the surface with hoes and drags has been found to answer; also *Pigs have been found to search busily for the grubs*, and if sent out (not too heavily ringed in the nose) on land newly disturbed or then being turned, would lessen infestation at little cost.

Where land has been infested in autumn, it would certainly do good to disturb the surface during winter to a depth which, if it did not throw the grubs out, would let the alternate effects of frost and wet go down to them. They will stand any ordinary amount of cold in their self-chosen or formed shelters, but if thrown on the surface in alternations of cold and wet weather, this takes effect and has been found a sure way of clearing out infestation.

For Turnip Gall Weevil, see Cabbage and Turnip Gall Weevil, p. 35.

PART II.

FOREST TREES

AND

INSECTS THAT INJURE THEM.

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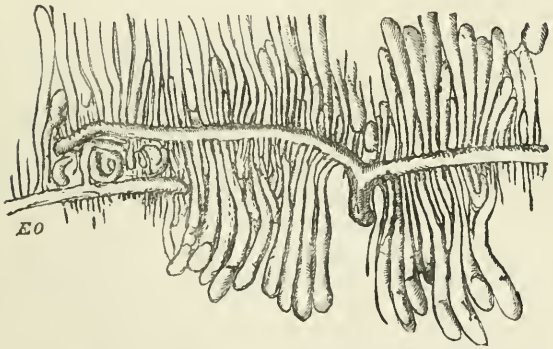
ASH.

Ash-bark Beetle. *Hylesinus fraxini*, Fab.



Workings of *Hylesinus fraxini*, showing forked "mother gallery," with larval galleries from the sides.

The *Hylesinus fraxini* is injurious, both in the beetle and grub state, to Ash trees, by boring galleries beneath the bark, sometimes slightly cutting into the outside wood of the tree. The beetles are often attracted in large numbers by newly-felled Ash trunks, in the bark of which they propagate, and from whence the new brood spreads to the neighbouring trees, mainly attacking those that are sickly or decayed; or young trees, which they sometimes injure to a serious extent. The damage is caused not only by the bark being loosened and the regular circulation of the sap interfered with, but also by the multitude of small holes which the beetles bore in escaping

after they are developed, allowing rain or moisture to soak into the substance of the bark and cause decay.

The larvæ are small whitish fleshy legless maggots, much like those of *Scolytus;* the head is furnished with a pair of jaws, by means of which the maggot gnaws its gallery beneath the bark.

The beetles are about the sixth of an inch long, of various dusky shades from black to ochreous, covered with an ashy down beneath, and mottled with ashy or brownish scales above. The head is short and robust, horns red, lowest joint longest, and the end club-shaped and pointed at the tip; body behind the head stout, convex; abdomen short, ovate; legs pitchy, and feet red, with the third joint deeply notched.*

The following notes are from personal observation of the method of attack on trees newly-felled in the neighbourhood of Isleworth:—

The beetles appeared about the 19th of April, and after wandering about on the bark for a few days the workings were begun by each beetle boring a circular hole just large enough to admit it. Here it was shortly joined by a companion, and pairing took place.

At about half an inch at most from the entrance, instead of carrying the tunnel straight forward (as with those of the Elm-bark Beetle), the workings forked, and the two galleries were carried on to right and left, until, in about five weeks they were at their full length, and the working was shaped much like a ⊤ with a short stem. During this time one beetle was usually to be found in each of the side galleries, but occasionally they were together.

By the 4th of July most of the parent beetles were dead in their burrows, and a few of the grubs, hatched from the eggs which had been laid along each side of the tunnels, had begun their borings; about three weeks later these larval tunnels were to be found completed, and pupæ were then fairly numerous in the cells formed by each larva at the end of its gallery. The beetles began to appear about the 10th of August: each beetle as it developed eating its way out, and soon, from the number of these perforations, giving the bark an appearance as if it had been riddled by shot-holes.—(See my observations published in 'Entomologist,' 1877.)

Prevention and Remedies.—The damage caused by these beetles is chiefly to decayed or sickly trees, or to young trees; the attacks on felled trunks are only of importance by serving to propagate the pest.

* Fig. "3" of the *Hylurgus piniperda* (for reference to this, see Index) gives a good general idea of the appearance of the *H. fraxini*, a little larger than life.

Attention to suitable locality and soil, and such management as may keep the trees in health, is the best method of prevention. The Ash has a large number of lateral fibrous roots, and likes "a good dry soil within reach of water." "A free loam with a mixture of gravel" is considered suitable, but a boggy soil or low swampy ground, or stiff clay, are not suitable to its continuous healthy growth.

Judicious thinning and removal of injured or infested branches are important matters.

The Ash likes shelter, but if plantations are allowed to run on too long without thinning, it suffers much from the sudden exposure; and where dead or dying boughs have not been removed, these attract insect-attack, which spreads till the ruin of the whole tree ensues.

Careful removal of dead, or decaying, or sickly boughs, or such as are suffering from insect-attack, is highly desirable.

Where felled wood is found to be attracting attack (which may be easily known towards the end of April by the little heap of chips lying at the mouth, or below the mouth, of each beetle-burrow) the removal of the bark is a sure remedy. If, however, barking is a heavier operation than is wished, a good thick coat of mud laid on the timber and well rubbed into all the crannies is a very fair protection, particularly if some paraffin is stirred into the mud before application.

With regard to attack on live trees, this should be watched for between the middle of April and of May, and if chips are found to be thrown out from small burrows about as large as a shot-hole, measures should be immediately taken.

The best method is probably to set a man with ladder and pail to rub a good coat of soft-soap into accessible parts of the tree by means of a common scrubbing-brush, or a rough cloth, or in any other way that may be more convenient.

In a case like this, where the season of attack probably only lasts for a short time and the injury is often to a few trees, it is well worth while to stop it at once; and a coating of any substance that is offensive to the insect, and, like soft-soap, chokes up its breathing-pores, clings to its limbs, and fills up its galleries in the tree, is sure to be serviceable, but any application which is not injurious to the tree, and will gradually be washed off by the rain, will be of use.

BIRCH.

Gall Mite. *Phytoptus* (? sp.)

Gall Mite of the Birch, mag., nat. length two-hundredths of an inch; egg, also greatly magnified; deformed shoot (smaller than life).

The Witch-knot, or great bunch of twigs looking like a large bird's nest fallen at random amongst the branches of the Birch, may frequently be noticed; and amongst the various forms of galls caused by *Phytopti* this peculiar growth of twigs in the Birch tree is of some interest, from the attack of the Gall Mites producing an increased development of woody growth from the infested buds, instead of—as is usually the case—leaf-galls, or diseased leaf-buds alone.

As far as I am aware up to 1876 this special attack had not been studied, and the following observations on the origin and progress of this diseased formation were taken by myself in part from so-called "Witches' Brooms" growing in Savernake Forest, near Marlborough, and also from growths on Birch trees planted by the roadside at Spring Grove, near Isleworth, which (probably from the unsuitableness of the situation) suffered so much from Gall Mite that, whilst resident there in 1876 and 1877, I was able to trace the effects of the infestation from the beginning.*

The *Phytoptus* causing the diseased growth is greyish-white, cylindrical, and rarely exceeding one two-hundredth of an inch in length, and a quarter of that measure at its

* In the 1st Edition of my 'Manual,' I gave a short note regarding this attack, which was all that space would permit, but now, as the infestation is of some interest, I reprint by permission most of the information, together with the figures drawn by myself from life, from my paper given in the 'Entomologist,' vol. x., 1877 (No. 167). Messrs. Simpkin & Co., London.

greatest width; but its powers of elongation and contraction make it difficult to give more than an approximate measurement. From the insertion of the legs to the caudal foot the *Phytoptus* is marked with transverse striæ of such minuteness as to give about a hundred to the length of the body, these in the early life of the Gall Mite being deeply corrugated; when full grown the bands are marked with dots, about thirty-two to the circumference of the mite, having a projection, when seen against the light, as if possibly composed of a pencil of short hairs. The legs, at full stretch, only extend about half their length beyond the head, and when in motion the difference in form between the species of sucker-foot and the neighbouring bristle appendages is clearly visible. In the act of walking the terminal portions of the leg are pressed down so as to be almost at right angles with the parts above, and the sucker-foot may be seen with a small enlargement at the extremity while free; when the leg is drawn forward in the act of being raised the appendage may be seen curved backwards as if still adherent, and then loosened and withdrawn with a sudden jerk.

The figure (p. 212) represents the *Phytoptus* much magnified, but still, from the exceeding minuteness of the mite, gives only a general idea of its structure. The caudal extremity was somewhat lobed and capable of being curved downwards, and of free use as a caudal foot of sufficient power for the Gall Mite to raise itself on it completely free of other support. On each side of this caudal foot is a stout bristle, and at a short distance a smaller pair is set on the upper part of the back. Three other pairs are placed—one just behind the insertion of the legs, the others at short distances from them along the sides of the body. These hairs appear, excepting in the case of the caudal bristles, to be frequently deciduous after death; but whether from their absence, or from not having a sufficiently powerful object-glass to discover them, I was unable to see more than these five pairs of bristles on or under the body. The corrugated furrows beneath, behind the insertion of each pair of legs and of the head, with their longitudinal lobes, and the movement of the mouth, as the mite moved it on the surface of the slide, were clearly discernible.

The formation of the Witch-knots begins with a diseased growth of the mite-infested bud, which is distinguishable by its swelled, irregular, loosely-opened appearance, from the smooth and pointed shape of the buds in healthy condition; and presently, as shown in figure (p. 214), the attacked shoot is thickly covered by the buds, which in healthy growth would have been distributed at distances of some inches along it. As

time goes on, repeated forkings of the twigs from these unhealthy and infested buds, and from successive growths of the same kind, give rise to the knotted and confused masses known as Witches' Brooms. Sometimes these make little progress, and the knot merely resembles a rough mass like an old Rook's nest thrown down and hanging loosely from the Birch-bough; sometimes the twigs regain healthy growth, and pushing on for as much as a yard in length form a pendant mass of some beauty, from the delicacy and gracefulness of the sprays.

1 2 3

Buds of Birch infested by Gall Mite.

The infested buds figured above, magnified at fig. 1, may be distinguished by their spheroidal shape, greater size, and loosely imbricated irregular scales, from the natural growths, which are smooth and lanceolate in general outline. A few months later (about the beginning of February), a touch to one of these distorted buds will often throw off all the diseased scales, and at their bases the coming growth will be found in the numerous minute round buds set close together on the common thickened centre, as shown (magnified) at fig. 2. The growth of the knot from these embryo buds is the work of years; but whilst the tree is still bare of leaves it may be found in every stage of progress: the shortened shoot beset with swollen buds, as (magnified) at fig. 3; the compound form, where many buds have grown close together so as to present a hard cluster, with a few shoots starting from it (figured page 212), and so onwards, till the Witch-knot is fully formed, a mass sometimes more than a yard in diameter.

In November I found the four-footed *Acarus* (*Phytoptus*) to be present in an active state, amongst the inner scales, in numbers that might be counted by dozens or scores; and about the beginning of February I found numerous egg-like bodies amongst the diseased leaf-scales, from which *Phytopti* were shortly after disclosed, occasionally perishing whilst partly excluded from the pellicle, so as to give ample opportunity for examination. These eggs were bluntly ovate (as

figured at p. 212, magnified), much produced and lobed at one end, in a way that would correspond with the caudal extremity of the contained *Acarus*. The pellicle was similarly transversely striated, and, before the exclusion of the contained Gall Mite, was dragged out of all resemblance to the form of an egg, and left sometimes with the markings at the two extremities, having much the appearance of a cast skin, except in the absence of limbs and appendages.

Later on in 1877 I continued the search, and found at the beginning of August what I took to be an earlier form of the egg. In this case the egg was of a perfectly regular oval shape, larger at one end than the other, and without striæ; sometimes also slightly produced at the extremities as from pressure of the contained creature, and sometimes also when the time of hatching was at hand these eggs were to be found as before, with the pellicle striated, the shape completely irregular, and the *Phytoptus* in the act of exclusion.

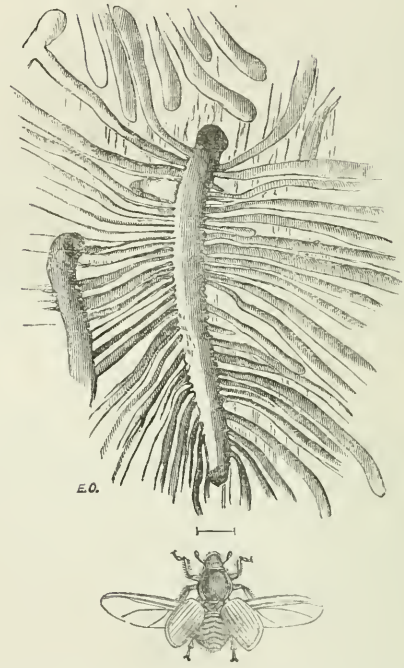
Towards the end of August eggs were still to be found of a regular obtuse oval until driven out of shape by the living tenant.

Prevention and Remedies.—Witches' Brooms should be cut off and burnt, and in cases where the tree is much infested with the small gradually-forming tufts of diseased growth it is desirable to cut it down and burn the mite-infested twigs. The Gall Mites have no power of flying, but the wind wafts them about on leaves or broken twigs, or birds carry them in their plumage, and when once well established the attack spreads regularly onwards slowly but steadily to the neighbouring Birches.

During the last few years Gall Mite attack to the leaf and flower buds of Black Currants has increased to a very serious extent, so as to cause great loss to fruit-growers. This is referred to under its own heading, but as (from their excessive minuteness) there is great difficulty in ascertaining whether there is specific difference in *Phytopti* infesting different kinds of plants, the above notes may be of some use as to the general character of the infestation.

ELM.

Elm-bark Beetle. *Scolytus destructor*, Oliv.



Beetle magnified; nat. length, 1½ to 3 lines; workings in Elm-bark, showing central mother-gallery, and maggot-galleries from it.

This beetle is well known as causing much injury to Elm trees by means of the galleries that it bores between the bark and the wood, mainly in the soft inner bark, but so as also to leave just a slight trace of the working on the surface of the wood.

The females may be seen early in June, making their preparations for egg-laying by working their way along the bottom of cracks in the bark, which they widen for some distance before beginning to burrow, so that the real opening of the galleries may be at some distance from the heap of rejected matter or little heap of wood-dust that marks the first point of entrance.

The male is present for only a short time after the burrow is begun, before egg-laying commences.

The burrow of the parent beetle is usually about three to five inches long, and takes about three weeks to form. The eggs are laid along each side of it, and are a hundred and upwards in number. As many as a hundred and sixty have been observed.

The young grubs, when hatched, start at right angles from the parent gallery, and gnaw their way onwards, the burrows gradually increasing in size and curving to allow room for the growing size of the tenant (as shown in the fig., p. 216).

Most of the larvæ are full fed towards the end of July, when some turn to pupæ at the end of their burrows, and the beetles from these pierce the bark and come out from the tree during August. The greater number, however, of the grubs, appear to form a little chamber, either just within the wood or in the thick bark, where they pass the winter, and come out as beetles about the end of May; thus, in case of the bark being removed or falling from the tree, although the beetle-maggots in the open galleries beneath it are exposed, to be cleared off by the birds, the others buried in their chambers, with the openings stopped up by the rejected matter, are safe from attack.

The maggot is whitish, curved, tapering bluntly to the tail, fleshy, much wrinkled across and legless.

The beetles are black, from an eighth to a quarter of an inch in length, with rounded rough head and reddish horns; wing-cases rounded at the sides, and cut short at the tip, pitted lengthwise with rows of dots, with irregular punctures between, glossy, and sometimes of a pitchy colour or rusty red; abdomen cut short, slantwise beneath; legs pitchy; feet reddish.

It has been observed that these beetles prefer a tree that has already been attacked rather than a young and vigorous one, and it is easy to tell where they are or have been present by the great number of small holes, as if the bark had been pierced by shot or holes made by a brad-awl, and also (whilst the beetles are boring their way out) by the wood-dust observable on the bark, or fallen on the ground beneath the openings of their burrows.

The circumstance of *Scolytus* attack, and sickly growth of the tree or decay of the bark occurring together, has given rise to much discussion as to whether the *Scolytus* attack caused the decay, or weakened health induced attack.

It is observed by Dr. Chapman, from whom I take much of the above life-history (see 'Entomologist's Monthly Magazine,' 1869, pp. 126, 127), that healthy growing trees are supposed to repel the attacks of this genus of beetles by pouring sap into their burrows. He notes that in the case of

the *Scolytus pruni* he had observed "burrows less than one inch long, some of which, containing a few eggs already laid, had been abandoned uncompleted by the beetles, apparently on account of the presence of a fluid which must have been sap, as no rain had fallen to account for it."—(Ent. Mo. Mag.; Illus. Brit. Ent.; &c.)

Prevention and Remedies.—One method of remedy which appears to be worth consideration is that adopted with great success in France by M. Robert, after careful observation of the circumstances which stopped the operations of the female beetle when gnawing her gallery for egg-laying, or which disagreed with or destroyed the maggots, and is based in part on similar observations of the effect of flow of sap to those noticed in England by Dr. Chapman.

It appeared, on examination, that the grubs died if they were not well protected from the drying action of the air; on the other hand, if there was a very large amount of sap in the vegetable tissues that they fed on, this also killed them, and it was observed that, when the female was boring through the bark, if a flow of sap took place she abandoned the spot and went elsewhere. It was also noticed that the attack (that is, the boring of the galleries which separates much of the bark from the wood) is usually under thick old bark, such as that of old Elm trunks, rather than under the thinner bark of the branches. Working on these observations, M. Robert had strips of about two inches wide cut out of the bark from the large boughs down the trunk to the ground, and it was found that where the young bark pressed forward to heal the wound, and a vigorous flow of sap took place, many of the maggots near it were killed, the bark which had not been entirely undermined was consolidated, and the health of the tree was improved.

Working on from this, M. Robert tried the more extended treatment of paring off the outer bark, a practice much used in Normandy and sometimes in England for restoring vigour of growth to bark-bound Apple-trees, and noted by Andrew Knight as giving a great stimulus to vegetation. M. Robert had the whole of the rough outer bark removed from the Elm (this may be done conveniently by a scraping-knife shaped like a spokeshave). This operation caused a great flow of sap in the inner lining of the bark (the liber), and the grubs of the *Scolytus* beetle were found in almost all cases to perish shortly after. Whether this occurred from the altered sap disagreeing with them, or from the greater amount of moisture round them, or from the maggots being more exposed to atmospheric changes, or any other cause, was not ascertained,

but the trees that were experimented on were cleared of the maggots. The treatment was applied on a large scale, and the barked trees were found, after examination by the Commissioners of the Institute at two different periods, to be in more vigorous health than the neighbouring ones of which the bark was untouched. More than two thousand Elms were thus treated.*

A somewhat similar process was tried by the Botanic Society in 1842 on trees infested by the *Scolytus destructor* in the belt of Elms encircling their garden in Regent's Park, London; "it consists in divesting the tree of its rough outer bark, being careful at the infested parts to go deep enough to destroy the young larvæ, and dressing with the usual mixture of lime and cow-dung." This operation was found very successful, and details with illustrations were given in a paper read in 1848 before the Botanic Society.

Various kinds of mixtures or dressings have been recommended to be applied directly to the bark, in order to keep off beetle attack, and anything of this kind that would make the surface unpleasant to the beetle would certainly be of use so long as it was not of a nature to hurt the tree, and if previously the very rugged bark was partially smoothed it would make the application of whatever mixture might be chosen easier and more thorough.

Washing down the trunks of attacked trees has not been suggested, but, looking at the dislike of the female beetle to moisture in her burrow, it would be worth while, in the case of single trees which it was an object to preserve, to drench the bark daily from a garden-engine for a short time when the beetles were seen (or known by the wood-dust thrown out) to be at work forming burrows for egg-laying. Where a stronger application was needed, some of the various kinds of soft-soap wash with a little mineral oil added, or a small quantity of Paris-green (see references in Index), could not fail to be very deterrent, if they were thrown in solution sufficiently thick to settle into and choke the crannies or deep cracks especially chosen by the beetles as the points from which to start their burrows.

One of the most important considerations, in regard to prevention of attack, is the removal of all centres of infestation from which the beetles might spread to the sound trees.

The possibility of clearing away or treating infested standing trees or infested limbs depends, of course, on local circumstances; but whatever care is exercised in other ways, it is very unlikely that much good will be done in lessening

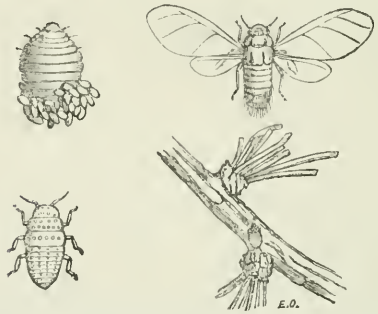
* The above account is abridged from the leading article in the 'Gardeners' Chronicle and Agricultural Gazette' for April 29th, 1848.

attack so long as the inexcusable practice continues of *leaving trunks of infested Elms lying, with their bark still on, when containing myriads of these maggots, which are all getting ready shortly to change to perfect beetles, and to fly to the nearest growing Elms.* Such neglected trunks may be seen in our parks and rural wood-yards all over the country, where, without difficulty (as I have myself often found), the hand may be run under the bark so as to detach feet and yards in length from the trunk all swarming with white *Scolytus* maggots in their narrow galleries.

This bark, with its contents, *ought never to be permitted to remain.* Where it is loose it may be cleared of many of the maggots by stripping it off and letting the poultry have access to it; or, if still partly adhering, it may be ripped from the wood by barking tools, and burnt, but if allowed to remain swarming with maggots it is a tangible and serious cause of injury; and if our landed proprietors were fully aware of the mischief thus caused to their own trees and those of the neighbourhood they would quickly get rid of it.

LARCH.

Larch Aphis. *Chermes laricis*, Hartig.



Female, with eggs, winged specimen, and larva; all magnified.
Twig, with females and eggs, slightly magnified.

The attack of this Aphis, known also as Larch Chermes, Larch Bug, or Larch Blight, causes injury by means of the insects in all their stages piercing the tender bark or leaves of the Larch with their suckers, and drawing away the sap. It occurs on old as well as young trees, but is most injurious to

the latter by reason of the larger proportion of the tree liable to attack.

The *Chermes laricis* never produces living young; it propagates entirely by eggs, and when the Larch leaves are beginning to appear in the spring, the mother Chermes may be seen at the base of the leaf-knots along the Larch twigs, laying the eggs which will give rise to the successive generations of the year. These eggs are oval, and furnished with a kind of hair-like stalk; of a yellow or yellowish purple colour at first, which deepens in tint towards hatching-time to a dark violet. They are laid slowly (sometimes at the rate of about five a day), and more or less covered up with a kind of powdery down removed off herself by the mother, and gradually are piled round and over her till she is half-buried in them, and in hardening drops of turpentine which she constantly exudes with a kind of pumping motion.

This female, the mother of the colony, is of the shape figured (p. 220), greatly magnified; wingless, with short legs, and a strong sucker; dusky violet in colour, becoming darker with age, and more or less covered with a white powdery or cottony secretion. The legs and sucker are dark, or black.

The young soon hatch; eggs may be found in the south of England in course of laying on the 22nd of April, and twigs swarming with young at the beginning of May. These are of the shape figured opposite, with distinctly formed head and horns; trunk (or thorax) with six legs, and abdomen: at first they are of a powdery black, or violet, with several rows of tubercles along the abdomen, and (though not showing as clearly) also along the trunk; afterwards they change "to an olive-yellow or clear olive-green, with horns, legs, and sucker, darker olive-green or olive-brown."—(C. L. K.) These disperse themselves over the leaves, and, piercing into them with their suckers, begin the work of mischief, and the infested shoots may be known by the Chermes scattered over the leafage, like little black or darkish specks bearing bunches of white down. Later on—about the middle of May—fully developed winged as well as wingless specimens may be seen: the winged females of the shape figured, of a yellowish tint, with brown head and horns, and various brown markings; and with wing-veins of a yellowish green. The reader is requested to notice that the long vein forked at the end, placed at the fore edge of the upper wing, has only *two* side veins from it: this veining of the wings is characteristic of the tribe *Chermisinæ*, and distinguishes it from the three other tribes of the *Aphididæ* (for details of wings, see "Aphides" in Index).

The Chermes-attack continues, or may continue, unless

checked by weather or special circumstances, till August or later, and the last laid eggs of the year produce again the large shapeless "mother Chermes," the foundress of the family of each successive year, which lives through the winter, and in spring lays her eggs as above described.

Descriptions of the male *Chermes laricis* have been given, but up to the beginning of 1881 our best authorities on the subject considered that it had not been observed, and I am not aware whether it has been discovered since. The above notes are mainly taken from 'Mon. of Brit. Aphides,' and observations by Editor.

Prevention and Remedies.—The following remedies have been of service in checking attack of Larch Bug when already commenced :—

A note is given of a plot of young Larches planted in nursery-ground a year previously, which became so badly infested with "Bug" in May that they appeared as if covered with mould, with the sap exuding over the stems, so that the shoots were soft and supple, and the plants becoming rapidly exhausted. These were watered over head with dilute paraffin, in the proportion of a wine-glassful of paraffin to a watering-can full of water, and the first application checked the depredations of the Bug. The waterings were repeated at intervals of three or four days, for about three weeks, when the plants were entirely cleared of the Bug, and assumed a healthy and vigorous appearance. The application was found similarly serviceable in clearing Pine Bug, and in no way injurious to the trees when applied judiciously.—(J. K.)

The following remedies have proved efficacious in destroying "Bug," and preventing attack on Larch and Silver Fir.

One method is as follows :—To every thirty-six gallons of water add half a pound of perchloride of mercury ; with this the infested trees are drenched in the early summer, when the sap is flowing freely ; a dry day is preferred for the operation, as it gives time for the solution to soak thoroughly into the bark. This has been applied to ornamental trees and plants in the nursery, and it is noted that trees operated on in 1873 continued, at the time of writing (1880), free from the "Bug" and in thriving condition. This application requires to be in careful hands, *being poisonous ;* Woodpeckers that fed on the poisoned insects were destroyed by it ; and especial caution is given against using it to fruit-trees.—(D. F. M'K.)

Another method found serviceable was the use of lime-water prepared and applied thus :—One hundred-weight of best lime-shell to eighty gallons of clear water : slake the shells in the water, and allow it to stand for a week ; drain off

the clear liquid, and wash or syringe the infested trees. This was found to clear the tree thoroughly of the Bug and eggs. The trees appeared to be a little sickened for a time, but all recovered.

Washing with lime and water was also found to answer both as a remedy and means of prevention, but made the tree unsightly.—(D. F. M'K.)

The use of quick-lime, in a plantation of Larches from eight to twelve feet high, is noted as "very disagreeable, and only partly successful." Tobacco-liquor is also mentioned as being applied for Aphis-attack to Silver Firs, the solution being rubbed on the tree and branches; this was more successful than the lime, but more expensive and difficult of application.—(J. M'L.)

Looking at the good effects both of tobacco and of soft-soap for general use in clearing off Aphides, it is probable that some of the Hop-washes in which these are combined (and which might be easily applied by a garden-engine) would be very serviceable.

The following recipe from amongst those given under the head "Hops" is simple, and found reliable for regular use in the Hop-gardens:—To thirty-six gallons of water in a copper add sixty pounds of soft-soap, then add either fourteen pounds of bitter aloes or two pounds of tobacco, and boil together. For use add thirty-six gallons of water to every gallon of this liquid.—(J. W.)

In dealing with the Larch Bug we have advantage from its flocky coat, as washings and dressings, especially those of a sticky nature, clog the down, and thus take good effect.

The amount of the presence of this Chermes (like that of other Aphides) appears to depend partly on such states of the weather and local atmospheric surroundings of the trees as may be suitable for increase of the insect, partly on the health of the trees, and also on their neighbourhood to such as are infested.

Late frosts are noted as being injurious to the Larch, and favourable to increase of the "Bug"; this, presumably, for the same reasons as in other cases of Aphis-attack that late frosts commonly accompany clear skies, with bright sunshine by day, and the sudden alternations of heat and cold are unsuitable for healthy growth, but cause a condition of sap suitable to the Aphides. In 1880, in which year the "Blight" was very prevalent, it was observed in connection with frost in June, and with hard dry winds; and, looking back to published records of former years, it is noticed as "most prevalent when the frosts were very severe late in the season."

The health of the Larch depends greatly on local condi-

tions; it suffers from drought and from exposure of its roots to sunshine, and also from a stagnant wet soil. Although it requires a constant supply of moisture for its roots, this moisture must be fresh, and free; and it needs a clear, dry atmosphere, with great amount of sunshine for its leaves.

A position amongst broken rock, with plenty of good loam, either on the side of a ravine or so placed that water may constantly trickle by, may be considered the type of what is most suitable for its growth; in its natural habitats it thrives best on declivities connected with summits of perpetual snow, by the thawing of which the plants are fed, and where their heads are well exposed to sunlight.

It has been pointed out by Prof. DeCandolle that the fine slender Larch leaves having less surface for action (that is, for elaboration of sap) than those of other deciduous trees, the action of the surface requires to be greater in proportion, to keep the tree in health; and from this, and also from observation of the localities in which Larch thrives, he shows the desirableness of a clear dry atmosphere, with plenty of sunlight, and freedom from fogs and damp, which tend to diminish the evaporation from the leaves necessary for the health of the tree; and—to give a single instance—it is noted that at a height near Geneva (not less than that at which fine Larches were to be found) the trees did not thrive near the lake and river, whilst in the dry air of the Alps they prospered.

It appears plain that any cause, great or small, that induces a damp stagnant atmosphere, or want of light round the Larches, will produce ill-health, and in such situations the Larch Bug thrives.

We may do something to diminish the amount of attack by planting on proper soil, and especially avoiding such flat moorish land as is likely to cause stagnation of moisture in the ground; and also by thinning Larch plantations in time, so as to allow as much sunshine as possible on the leaves; and all overtopping by deciduous trees should be carefully avoided.

Hopelessly attacked trees should be felled and all the twigs burnt, to avoid spread of attack; and in nurseries it might be worth while, besides the dressings given when the Bug is seen to be present, to give one or two thorough drenchings with soft-soap towards the middle or end of August, to deter attack when the eggs for next year's "mother Chermes" are being laid.

With regard to such connection as may exist between "Larch Blight" and the diseased cancerous formations known as "Larch Blister," we have no certain knowledge at present.

The causes mainly under consideration as giving rise to this

great evil are four:—fungus; frost-bite; "Blight," or Chermes-attack; and deranged circulation of the sap; and (without venturing to offer a definite opinion) many circumstances appear to point to this last, which may arise from any cause affecting the health of the tree, but especially from weather influences, such as rapid alternations of heat and cold, moisture in the air, and want of sufficiency of sunlight, as at least very possibly the cause of the blister.

Prof. De Candolle observes that, as an Alpine tree, the Larch is singularly free from disease, and the trunks remarkably healthy; and that, though sometimes Larches may be seen having a wound of "resinous cancer," it seems to proceed from some accidental cause, such as a blow when the tree was in full sap; and after noting that he considers the cause of diseases in British Larches must originate from some difference in the physical structure or culture of British or Alpine-grown trees, he observes:—"The want of a sufficiently intense light, owing to the obliquity of the solar rays, and to the opacity of the atmosphere; and the over-damp state of the latter, appear to me permanent causes, which, in your climate, must predispose the Larch to a kind of watery plethora."—(See Loudon's 'Arboretum,' vol. iv., p. 2384.)

It has also been observed that a form of blister affects young trees after being transplanted, in which case also the regular circulation of the sap is disturbed.

By examination of diseased specimens (although this is far from affording a complete view of all forms of the disease), the formation of the blister may be traced *backwards*, from the large open diseased wound, to the swelling just bursting, and not yet burst; and then (keeping as a guide the similarity of the diseased spots as shown microscopically) from a patch beneath the bark with no external swelling, to a few small spots connected by a canal, or to a single spot filled with brown disorganised tissue, which appears to me to be the origin of the evil.

In these spots (as far as observable in all the specimens examined by means of a quarter-inch object glass) there was no trace of Mycelium, or of any kind of fungoid presence; after a time, when the blister has become an open wound, it is impossible to say that *Corticium amorphum* (from which "blister" has been conjectured to arise), or other fungoid growths, may not be present, just as *Peziza* or other fungi may be found on the bark; but in all the first states of the blister that I have examined, whilst still it had not burst into an open wound, there has not been any such presence.

In these cases—that is, where the "blister" was originating from a mere speck—it differed markedly from the effect of

frost-*bite* on twigs of the same age, as the effects of the frost-bite which had then taken place a few weeks before affected the cells in the bark over a surface of several inches, and the condition of the many injured cells in this case, and of the one or few diseased ones in the other, was very different. This observation merely refers to the complete frost-bite, not to effect of weather on health of the tree.

Observations as to the state of the precise spot where the mother Chermes has been noticed to be attached by her sucker during oviposition would give much information as to whether any diseased state of tissues was set up by the irritation of suction; when once the disease has taken the form of an open wound it is very probable that the presence of *many* of the Chermes, sucking on such young diseased bark as they may find, would increase the commenced disease; but the great point is the *origin*.

This appears, as far as specimens show, to be *not a growth, but a death;* a spot or spots joined by canals filled with dead, discoloured and disorganised tissue, which may exist for one, or possibly two or three seasons unseen beneath the bark, until the consequent stoppage of sap causes a swelled growth, and the diseased mass, composed of the discoloured cells and passages, and the tumid swellings, is set on foot; and may be traced forward in section, increasing year by year from its starting-point.*

LIME.

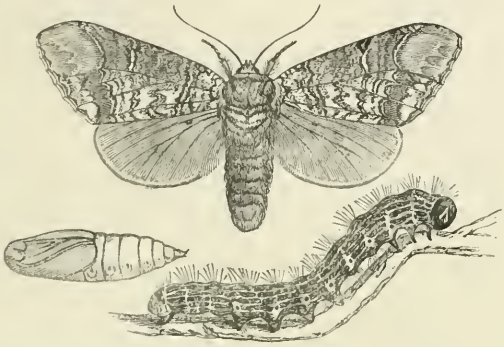
Buff-tip Moth. *Pygæra bucephala*, Steph. Cat.

The caterpillars of this Moth feed on the leaves of the Lime and also on those of the Elm, Oak, and other trees, sometimes doing thereby serious damage.

The eggs are laid during June or July, in patches of about

* The above remarks on Larch blister are offered with hesitation, as venturing on a subject where those who have better opportunity than myself for observations are still in doubt, and therefore I take leave to mention that they are mainly based on specimens forwarded for examination, or observations on Larch in West Gloucestershire; but not having the opportunity of studying the subject in the large plantations of the North, with the thoroughness requisite for a knowledge of the different developments of the disease, and the different coincident circumstances on which alone conclusions can be based, I merely give these points as all I have at present to offer.

thirty to sixty, mostly on the upper side of a leaf, and are distinguishable by being convex and white above, smoke-coloured and flat beneath, with a black dot in the middle of the convex part.



Female Buff-tip Moth, caterpillar, and pupa.

The caterpillars hatch in about fourteen days, and at first feed in company on the skin of the upper side and on the pulp of the leaf. After eight days they undergo the first moult (that is, cast the skin for the first time), and separate into parties of eight or ten, which feed at the edge of a leaf, but, when resting, place themselves side by side on its surface. When full grown, they are about one inch and three-quarters long, and sprinkled with silky hairs; the general colour yellow, with black head, black lines running from the head to the tail, interrupted by a transverse orange band on each ring, and a black horny plate above the tail-segment.

When full fed, which is towards the beginning of autumn, trees much infested by them may be known by the twigs of the higher and outermost branches (or, in bad attacks, almost the whole of the tree) being stripped of its leafage; the caterpillars then come down from the tree, and, without spinning any cocoon, they change at the roots of herbage, amongst fallen leaves, or on or just below the surface of the earth, to a dark brown chrysalis, with two spines at the tail.

The moth (figured above, life-size) comes out in June. The fore wings are of various shades of pearly or purplish grey, with rusty coloured and black markings, and a yellow or buff patch at the tip, whence the moth takes its name of Buff-tip; the hind wings are whitish, with a dusky cloud towards the middle. The head is ochreous, and the body between the wings, and abdomen are also ochreous, but variously striped or spotted with more dusky or rust-coloured tints.—('Brit. Moths,' &c.)

Prevention and Remedies.—The method of getting rid of the caterpillars that is chiefly recommended is to shake the infested boughs; it is stated that, on this being done, they fall down "in a perfect shower" (E. N.); and when attack is found to have begun, this plan should be adopted at once.

Any method by which the boughs or infested twigs can be shaken will answer, such as jarring the larger boughs with a pole, or throwing sticks or handfuls of gravel at such parts as may be out of reach; but a better plan would be for a man to go up the tree, and, by means of a strong pole furnished at the end with a worn-down birch-besom, to shake all the infested boughs thoroughly, beginning at the uppermost and working downwards, so as to shake off the caterpillars that may have lodged in falling on the lower branches. The addition of this worn-down stump at the end of the pole makes it a much more effective instrument, for, by using it upright, the smaller boughs can be lifted up sharply, to come down with a jerk; or a heavy blow can be given that will shake all twigs near without any injury to the tree, whilst in the case of the sharp knock of hard wood on soft bark given by the pole, much harm is apt to be done.

Before beginning the operation, a good thick band of hay or straw, or cloth well tarred, should be put round the foot of the tree, to prevent the caterpillars getting up it again; for directly they reach the ground they start on their return journey towards the trunk, and, unless they are stopped, will soon be once more at work on the leaves. All that fall to the ground should be crushed with the foot, or killed in whatever way may be most convenient; and where a tree is much infested it would be worth while to spread large cloths or pieces of tarpaulin, or anything that might be preferred, beneath it, upon which they would fall, and from which they might be collected more easily than from the grass.

The large size of this insect in all its stages and its habits throws it open to attack. "At the beginning of June these singular moths may be frequently found coupled in pairs on the trunks of Lime, Elm, and other trees, or on the herbage below them; the truncate heads and closely-convolute wings giving each pair the appearance of a single piece of dead and dried stick."—('British Moths,' by Edward Newman.)

By destroying the moths at this stage many future broods are got rid of. The chrysalids may be collected by children for a few pence, under or near trees where the caterpillars have been numerous; and poultry also are of service, as they will search eagerly for them.

When the caterpillars are about to change, they are so conspicuous, from their bright colouring, large size, and

habit of straying about everywhere in full daylight, that many might be captured and killed (as above mentioned) by children.

As the caterpillars come down the tree to the ground for their change to chrysalids, it might be worth while to throw a few spadefuls of gas-lime or of anything they would not cross, in a circle at about a yard or two *from* the tree; or a rough band of any material soaked in tar, or tar and oil, which would keep wet longer, would stop them from straying off. It being matter of instinct for these caterpillars to come down to the ground for the change to the chrysalis state, probably few, if any, would return up the trunk, and they might be cleared in sufficient numbers as to considerably lessen future attack.

OAK.

Cockchafer. *Melolontha vulgaris*, Fab.

Common Cockchafer, larva and pupa.

The Cockchafer, known also as the May Bug, is injurious both in the larval and perfect state. As a grub it feeds underground on the roots of grass, vegetables, and young trees; as a beetle it feeds on the leaves of Oak, Elm, and other trees,

sometimes entirely stripping the foliage. The eggs are white or pale yellow, and are laid (early in the summer) about six or eight inches below the surface of the ground, the female burrowing down to deposit them, and laying thirty or more, near together amongst the disturbed earth.

The grubs are thick and fleshy, white or yellowish in colour, with strong jaws, and three pairs of legs; and usually lie on one side, somewhat curved together (as figured, p. 229). At the commencement of spring they come up to within a few inches of the surface of the ground, where they feed on roots of growing plants; and at the end of the third summer, when full fed, they again go down into the earth to a depth of two feet or more, and change to pupæ (as figured, p. 229) in oval cells.

During the following winter they develop into the perfect Chafers, but do not come up through the ground until the next summer, that is, the fourth year since they were hatched, when they may be found as early as May hanging half-torpid or sluggish beneath the leaves during the day, and coming out on the wing during the evening, when they fly in search of their mates or feed on the foliage of the trees.

The beetle is too well known to require description, but it may be observed it is about an inch in length, densely covered with down on the breast, and more or less throughout; part of the front of the face and the wing-cases are rusty or brown, the latter having five raised lines running along each; the abdomen is prolonged into a tip curved downwards, and marked at the sides with alternate triangular patches of black and snow-white; and the horns are terminated by fans or clubs of seven leaves in the male, six leaves in the female.

Prevention and Remedies. — When the May Bugs or Cockchafers appear in the large quantities sometimes recorded, as when eighty bushels are stated to have been collected on one farm ('Encyc. of Agriculture,' 2nd ed., p. 1166), it is worth while to beat or shake them from the trees, preferring noon-time or early on a bright warm day, when the beetles are clinging beneath the leaves and are dull and sluggish.

They may be shaken down on to large cloths spread beneath the tree, or may be swept together and destroyed, taking care in either case that the Chafers are collected before they have time to recover from the fall and take wing. Pigs will eat them greedily, and so will poultry; and, if there are more than can thus be got rid of, the services of some boys to trample on or otherwise destroy the shaken-down beetles would probably do all that was needed.

The grubs are sometimes very hurtful to roots of trees. In 1882 I had a report from Mr. T. J. Turnbull, agent to the Earl of Shaftesbury, relatively to the very serious injury caused by Cockchafer grubs to young seedling Firs. In this case the young plants, which were about 10 or 12 inches high, were being destroyed by the gnawing of the grubs removing the bark in large patches from the main root. It was observed that thousands of the Fir plants had been destroyed by the grubs in the previous year, and they appeared likely to do as much in the season then present. Mr. Turnbull also remarked that "they did not seem to inhabit the black sandy soil, but made their home in the stronger clay loam." This preference of special soil has also been observed in clearing Chafer grubs from roots of Coffee-trees in Ceylon; the diggers, on being asked why they did not search, considered the nature of the soil a sufficient reason, and it appeared to be so.

Whether it would be worth while to clear out the grubs by hand in infested young nurseries would be for the owners to settle; but there appears to be no other remedy excepting taking care that Rooks or others of the various kinds of insect-eating birds, which will eagerly devour the grubs wherever they find them, should not be driven off.

From the circumstance of the Cockchafer grubs feeding amongst roots and giving no signs of their presence till the fading of the attacked plant draws attention to the injury going forwards, it is difficult to find any remedy, excepting by means of the insectivorous birds, which appear to have an instinctive knowledge of the position of the larva below the surface.

Where infested Grass-land has to be broken up, or other land which has been infested is bare of crop, ploughing or well breaking up the surface to a depth that will reach the grubs, and turning on pigs to follow the plough is a good plan.

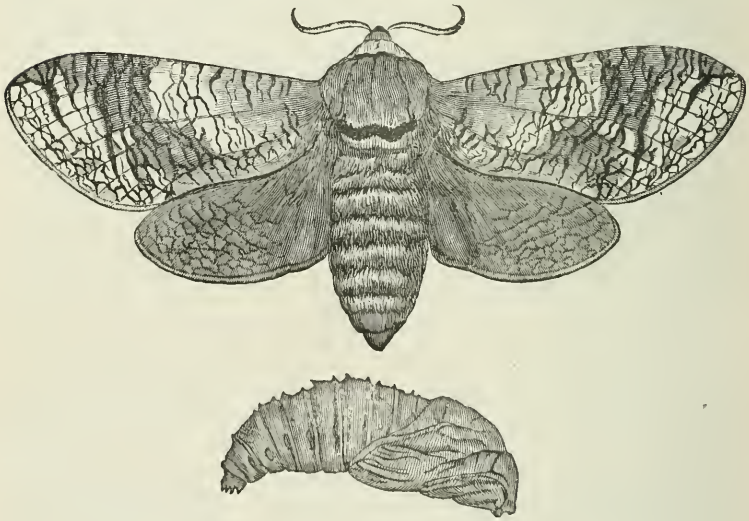
Hand-picking by children is of use, but probably in the fields the pigs would be the better helpers. Their instinct and fondness for the grub makes them hearty and well-qualified searchers.

Wild birds, such as Rooks, before mentioned, and Sea Gulls, should on no account be driven off. The Black-headed Gull follows the plough in the same manner as the Rooks, and feeds on Cockchafers both in the grub and beetle stages; the Common Gull will go for miles inland to follow the plough in search of insects and grubs; and the Nightjar, by "feeding almost entirely on Cockchafers (and moths)" during the morning and evening hours, is also of great service. Also, on

pasture lands where Grass has been seriously injured by Cockchafer grubs feeding on the roots, the birds should be carefully protected from molestation; they pull up little—if anything—more than the infested plant (which would have died), and are in this case almost our only means of clearing off these large grubs, which otherwise, excepting when changing their skins or torpid during severe cold, would continue feeding for three years.

This kind of attack is one which it is most difficult to find any means of dealing with so far as getting rid of the grubs is concerned; and, as far as I can find, no plan seems to be known, either in Europe, the East Indies, or the United States of America, for getting rid of them, excepting turning them out from the ground and destroying them.

Goat Moth. *Cossus ligniperda*, Fab.



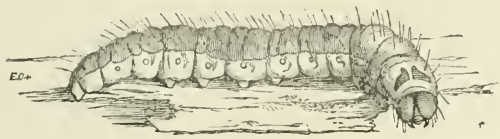
Goat Moth and chrysalis.

The caterpillars of the Goat Moth are often seriously injurious, sometimes totally destructive, to various kinds of timber and fruit-trees, by means of the large galleries which they gnaw in the solid wood. They attack Oak, Elm, Ash, Beech, Lime, Willow, Poplar, Apple, Pear, Walnut and other trees; and the infestation is to be found from the south of England to the north of Scotland. The worst attacks I have myself seen were in West Gloucestershire, where I have seen

sixty or more of the caterpillars taken from the stem of a young Chichester Elm. But the most important injury they cause is the damage to Oak timber.

The habit of the Goat Moth is to lay her eggs at the lowest part of the tree, and a badly infested tree may often be known by the wood-chips thrown out from the caterpillar-workings, which lie on the ground close to the trunk, as well as by the moisture where sap is oozing from the gnawed-out tunnels; likewise by the very offensive smell of the caterpillars, which thoroughly impregnates their tunnels and all about them, and from which the Goat Moth takes its name.

The eggs are laid about the middle of the summer in crevices in the bark, and the caterpillars which hatch from them feed at first in the bark or just within it, and gradually, as they grow, penetrate into the solid wood, where they live for three years, and form chambers and galleries of various size and width, some as large as a man's finger; and from the great size the caterpillars grow to, likewise the numbers they are sometimes found in, they do great damage, or sometimes entirely kill the tree.



Caterpillar of Goat Moth (not full-grown).

The above figure gives the appearance of the caterpillar when about two-thirds grown. When quite young it is pink, almost precisely the colour of a boiled shrimp; when older it is yellow, with a black head, two black spots on the ring behind the head, and a row of dark reddish patches or a stripe of the same colour along the back. When full-grown the caterpillars are three inches or possibly more in length.

During the winter they lie quiet, otherwise they feed for a period of three years, and, when ready to change, form cocoons of little bits of wood roughly spun together just inside the entrance of their burrows, in which they turn to a reddish brown chrysalis. Shortly before the moth is ready to emerge the chrysalis forces itself partly through the cocoon, where the empty case remains sticking out from the tree, and is a useful guide as to timber being infested.

The moth is between three and four inches in the spread of the fore wings, which are mottled with ashy white, and rich brown, with many irregular black streaks and markings; the hinder wings are of a more dingy colour, with the markings

less distinct; the head dusky brown; body between the wings marked across with dark brown and grey or ochreous; the abdomen brown and grey in alternate rings. It is to be seen at the end of June and beginning of July.

Prevention and Remedies. — The moths are heavy and sluggish, and may be taken easily by hand as they rest quietly during the day on the bark of the tree out of which they hatched.

The caterpillars sometimes leave the trees, and may be found straying about in May and in the autumn, and in such case they should always be destroyed; but generally (as above mentioned) they change to chrysalids at the entrance of their burrows, and where trees are known to be infested these reddish chrysalids should be looked for during June or early in July, and destroyed where found.

Any mixture that can be laid on the tree, so as to prevent the moth laying her eggs on the bark, is useful.

A mixture of clay and cow-dung smeared over the bark has been found to answer well, and has the advantage of gradually washing or cracking off without injuring the bark beneath it. Soft-soap has also been found useful applied as follows:— Several pounds of the soft-soap are mixed in a pail with warm water to about the consistency of thick paint; the operator, who is also supplied with a bag of sand and a coarse cloth, dips the cloth in the soap and sand and rubs the bark thoroughly, and then, with a painter's brush, lays on a thick coat.

This treatment is a good means of preventing oviposition, and also of rubbing off or destroying eggs that may have been laid on the bark; but in some cases a good syringing with a garden-engine, of some of the soft-soap washes with a little mineral oil in them, might do better, for they would run down a little way into the ground, and thus deter attack which sometimes is begun a little below ground-level. In the case of an attack on some Poplars and Willows near Llanelly, S. Wales, of which specimens were sent me in 1883, the caterpillars had made their way into the wood at the lower part of the stems of the trees below the surface of the ground, and had bored upwards.

Where the caterpillars can be reached, the simplest and best method of getting rid of them is by killing them in their burrows by passing a bit of thick strong wire up the tunnel. A glance at the state of the end of the wire, when it is withdrawn from the hole, will show whether the caterpillar has been reached or not. If the end is found to have wet, white matter on it, the caterpillar has been reached. I have also

seen it answer very well to use a finer wire with the point turned back, so as to form a hook to draw the caterpillar out with. A surprising number may be taken out this way.

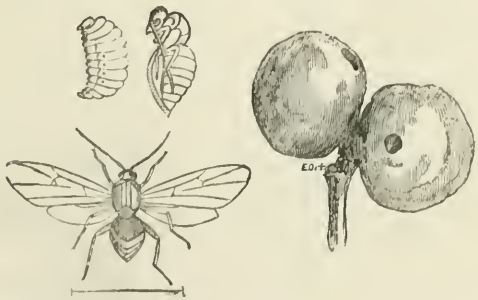
Paraffin oil, or a mixture of it in soft-soap wash injected by a sharp-nozzled syringe with as much force as possible into the holes where the caterpillars are working, is a good remedy; and any fluid poisonous to the caterpillar, or which would make the wood of its hole poisonous or distasteful to it for food, would be serviceable, as tobacco-water, &c. The fluid might also be easily injected by means of a gutta-percha tube, of which one end was fitted on the nozzle of a syringe, and the other passed a little way up the hole; the escape of fluid may be prevented by some soft clay being pressed into the hole round the tube or nozzle and also kept carefully in place whilst it is being withdrawn.

The fumes of sulphur blown into the hole were found very effective by Mr. Malcolm Dunn, of Dalkeith, in destroying the caterpillars of the Leopard Moth; and probably this application, or a strong fumigation of tobacco, would be equally serviceable in the case of the Goat Moth caterpillars.

Where a tree is much infested, it is the best plan to cut it down, split it, and destroy the caterpillars within; as many as sixty or more caterpillars may be taken from one tree, and when in this state it will never thoroughly recover, and it becomes a centre to attract further attack, as well as one to spread infection.

It has been noted by Prof. Westwood (Life-President of the English Entomological Society), that "the Green Woodpecker preys on these caterpillars, and its stomach on dissection has an intolerable stench."

Marble-Gall Fly. *Cynips kollari*, Hart.



Larva and pupa of *Cynips*; *Cynips kollari*, magnified; Marble Galls.

The "Marble Galls," figured (p. 235), seldom cause much injury, but they occasionally occur in such large numbers that they appear to be the most hurtful of the forty-two or more kinds of Galls which are to be found on Oaks in Great Britain.

Oak Galls infest all parts of the tree; some kinds occur on leaves, some affect the formation of the buds, others occur on the bark, root, and catkins, one kind is to be found in the twigs, and one in the acorn; but with the exception of the Marble Gall and the "Common Spangle" Galls (*Neuroterus lenticularis*), which sometimes so completely load the back of the leaves as to cause premature withering, it does not appear that any kinds are often materially hurtful.

The females of these Gall Flies (which belong to the order Hymenoptera) are provided with a peculiar apparatus for egg-laying, by means of which they are able to insert one or more eggs with a small quantity of fluid into the part chosen for attack, and thus set up an irritation in the living tissues which causes the diseased growth, resulting in the shape of galls.

In the case of *Cynips kollari* the egg is laid in the young bud when forming in the axil of the leaf, and the consequence is the globular growth of cellular tissue which we find (before the Marble Gall is mature), with the grub lying in the middle; towards autumn this changes to a pupa, similar to that figured (p. 235), and generally the Gall Fly comes out shortly after, but sometimes not until the following year, or possibly even later. It is furnished with four transparent wings of the expanse marked by the line beneath the figure (p. 235), the body and abdomen are of a rusty or ochreous brown, and the base of the abdomen pitchy. Up to the year 1881 females only had been observed of this species, and I am not aware of any discovery of the male having been recorded since.

This gall of the *C. kollari* was noticed in such great numbers in the south-west of England, about the year 1854, as to give rise to an impression that it had then first appeared in this country; and, from its being especially observed in Devonshire, the name of "Devonshire Gall" was bestowed upon it. Further investigation, however, showed that its presence had been noted previously, and that the appearance was only remarkable for its great amount; now it is widely spread throughout the country, and is to be found as far north as the hills of Bayndee, near Banff, and Redcastle, in Ross-shire.

Prevention and Remedies.—This gall is chiefly to be found

on low-growing Oak—such as trees stunted by want of shelter from sea-blasts or by other causes; Oak bushes in underwood and hedgerows; the shoots upon the stumps of felled trees; and also on young trees, and is especially undesirable in Oak nurseries.

It has been recommended to employ children to break off the galls before they are full-grown, and thus destroy the insect within in its maggot state; but this is but a rough remedy for the children would probably break off every leaf with the gall attached. It would answer better in nursery management for a man furnished with a common penknife to go through the trees whilst the galls were still young, and with a touch of the knife remove the gall without injuring the leaf. The operation would be an effectual cure, and very rapidly performed. In cases where the galls are formed in clusters of three or four to perhaps eight or ten it is desirable to cut the shoot off below the cluster. If the galls are cut off whilst they are still soft and young, there is no need to take the trouble to burn them; they will dry and shrivel, and the maggot within will perish. The encouragement of the Tom Tit, or Blue-headed Titmouse, and also of the Black-headed Titmouse, is an excellent means of prevention of increase of these Gall Flies in Oak nurseries. Where galls are numerous these birds are of great service, by making a rough hole in the gall and picking out the contained maggot.

Other larvæ or maggots, besides that of the *Cynips kollari*, are often to be found in these galls, sometimes what are known as "inquilines," or fellow-lodgers, which are dispersed in small cells through the substance of the gall; sometimes parasite larvæ, feeding on the larva of *Cynips kollari* in the large central cell.

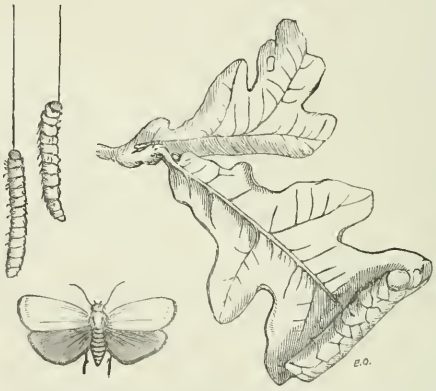
Common Spangle Gall. *Neuroterus lenticularis*, Ol.

Common Spangle Gall on Oak leaf, nat. size and magnified; also in section, magnified.

The gall of the *Neuroterus lenticularis* is distinguishable from the four other kinds of Spangle Gall found in Britain by its somewhat larger size, and also by being raised in the centre and hairy. It sometimes occurs in great quantities on the backs of Oak leaves, but rarely to an extent to cause serious damage.

In the above short notes I have not alluded to the variations of form which may exist, or may be supposed to exist, in alternate generations of various of the *Cynipidæ*, as these are rather points of curious speculation than serviceable for general use.

Oak Leaf-roller Moth. *Tortrix viridana*, Linn.



Tortrix viridana : Moth; caterpillars hanging by their threads, slightly larger than life; rolled Oak-leaf.

The caterpillars of this moth cause serious injury from time to time in our Oak woods and forests, especially in the south of England, by feeding in such vast numbers on the young leaves as to strip the trees of their foliage, and thus retard the growth of the first shoots, and injure or entirely ruin the acorn crop of the season.

The eggs are laid during the summer or autumn of the year preceding the attack of caterpillars, either on or in the leaf buds, or on the boughs (opinions differ as to the precise spot); but in the following spring, when the Oak leaves are appearing, the caterpillars hatch, and sometimes swarm in myriads over the infested trees on many acres of ground.

The caterpillars are at first greenish grey, or lead-colour, afterwards dull green, with head and tail-patch black, and

about half an inch long. They have the power of rolling the tip of the leaf and spinning it together into a cylinder (as figured, p. 238), within which, when full-fed, they turn to chrysalids; but meanwhile, on alarm or as matter of choice, they let themselves down by scores or hundreds by means of silken threads, for about seven or eight feet, and sway about as the wind may waft them beneath the infested boughs, catching on any passing object, being also a prey to many kinds of birds; but, if nothing else happens, they crawl presently back again, each up its own line to the bough. When full-fed—that is, towards the end of May—they turn to chrysalids either in tubes, which they have formed by rolling up the tip of the leaf and spinning it with threads into a kind of cylinder, or, if leafage fails them, to roll up or spin together, they wander away and turn to brown chrysalids in crannies of the bark of the trunks or boughs.

The moth, which appears towards the end of June, is about an inch in the expanse of the fore wings, with the head, body between the wings, and fore wings, of a light green; the hind wings are brownish or silver grey, and the fringes of the wings, as well as a line on the front edge of the foremost pair, are whitish.

Prevention and Remedies.—From the circumstance of the eggs of this moth being so small as not to be observable on the tree, and also from the caterpillar attack (which sometimes extends over miles of woodland) occurring at irregular intervals without any previous signs to give warning of its approach, it appears impossible, as far as is known at present, to apply any preventive measure of general service, excepting such as may be found in the encouragement of the wild birds.

In a very severe attack on the Oaks in 1827 it was observed that the Willow Wrens and Whitethroats were useful in clearing the caterpillars; the Chaffinch also; and the House Sparrows "were indefatigable in search of them"; and poultry searched under the trees for such as fell to the ground ('Mem. Lit. and Phil. Soc.,' Manchester, 2nd Series, vol. v.). Rooks, Jackdaws, Thrushes, Starlings, Titmice, Nuthatches, and Woodpeckers, are said to be of use in the matter; also Rooks and Jackdaws have been especially observed as flocking to the infested trees, and a second crop of leafage to be soon afterwards established. In a very bad attack of this Leaf-roller Caterpillar to the Oak woods at Tullamore, King's County, Ireland, in 1881, Mr. A. Henderson, writing from the spot, mentioned that they swarmed in thousands in every direction and exposure, and had it not been for the timely

attack made on them by the Common Rooks and the Black-headed Sea Gulls, scarcely a tree would have escaped them.

Where circumstances allow of drenchings, either of the soft-soap or other washes commonly used, being thrown at infested trees, this would do much good ; if the caterpillars are still present the operation would clear many ; or if the attack was passing away the drenching down of the tree would *clear* off much that would have started new attack presently ; and also the treatment is of great use in rapidly restoring the foliage, and thus reducing the amount of injury caused by the attack.

In June, 1885, by request of Sir H. Verney, of Claydon Park, Winslow, Bucks, I examined some of the fine old Oaks near Claydon House, which had been suffering from severe infestation of the *T. viridana*, and as on one of these (for special reasons) it was wished to restore the foliage as soon as possible, I advised thoroughly washing down the tree by means of the house fire-engine, throwing the water *not* broadcast amongst the boughs so as to tear or bruise any young leafage that was beginning to appear, but sending it directly at the trunk and large boughs. In this way the stream of water was thrown about in spray among the twigs, and thoroughly moistened every part, whilst the stream directed against the trunk cleaned out much of the insect-vermin that might be present, and the ground beneath the tree was thus so well moistened as to help the coming growth greatly.

A few weeks after the experiment, Mr. Sharp (the head gardener at Claydon Park) reported that :—"Through the soaking which we gave, the tree has recovered its foliage wonderfully. On all the parts on which we were able to play, the Aphides and all other insects, as far as I can discern, are cleared off, and I have no hesitation in saying that it is the right thing to do where trees are attacked, a fire engine kept, and water at command."

On the 20th of August Mr. Sharp further reported that it was wonderful to see how well the tree was then furnished with leaves.

Of course water supply, and means of throwing drenchings or spray, are not always at hand,—neither could such application be carried out in woods or forests; still there are cases in which the principle might be brought to bear, and the circumstance of destruction of moth-caterpillars by sudden wet as recorded by Curtis, in his 'Farm Insects,' many years ago ; and more recently by Mr. E. A. Fitch, late Sec. of the Entomological Society of London, on occasion of the great appearance of the *Plusia gamma*, the Silver-Y or Beet Moth, in Essex in

1879 (see my Report for that year, p. 5), bears very practically on the subject.

The following notes of temperature and rainfall, in connection with condition of the caterpillars, are also worth record. On one of the trees at Claydon, which was especially badly attacked, and especially under notice from historical interest, the caterpillars were observed to begin falling off in great numbers on the 11th of June, and lay putrefying beneath; and specimens of the putrid mass, as well as of the healthy chrysalids, to which some of the caterpillars had previously turned, were sent me.

Regarding the special weather conditions, I was favoured by Mr. Sharp with the following table of the maximum and minimum temperature at Claydon during the time when he observed the workings of the caterpillars :—

	Max.	Min.	Rain.
June 1	65°	42°	—
,, 2	74°	41°	—
,, 3	75°	45°	—
,, 4	83°	48°	—
,, 5	77°	56°	0·15 in.
,, 6	63°	53°	0·15 ,,
,, 7	68°	50°	0·05 ,,
,, 8	60°	54°	0·59 ,,
,, 9	64°	46°	—
,, 10	60°	44°	—
,, 11	67°	34°	—
,, 12	75°	45°	—
,, 13	76°	49°	—
,, 14	77°	49°	—

From this it will be observed that there was rainfall on four days after the max. temp. had risen to 83° in shade; but to continue in Mr. Sharp's own words, "It was on the morning of the 11th (of June), when our night temperature had been at 34°, that I first observed the caterpillars falling off in large numbers."

The matter of the fall of the caterpillars from the tree is of considerable interest, as an example of the effects of sudden cold and wet in destroying these plant-vermin, which might to some extent be copied artificially.

The carnivorous caterpillars of the Dun-bar Moth, the *Cosmia trapezina* scientifically, have been reported as sometimes doing great good in clearing away this attack. The *Cosmia trapezina* is a moth about an inch and a quarter in the spread of the fore wings, which are very variously marked with pale grey, rust-colour, or brown, with transverse

dark and pale lines, the hinder wings of a grey-brown. The female lays her eggs more especially on Oak; the caterpillars from these, which abound in May, feed mainly on animal food, and are especially serviceable in clearing off the larvæ of the "Winter Moth." These *Cosmia* caterpillars are of a general pale dull green, apple-green beneath, and have five pale whitish or yellowish stripes running their whole length, and have also numerous small black warts, each surrounded by a white ring (Newman's 'British Moths').

The above notes on Oak attacks are not offered as in any way giving an idea of the vast number of insect infestations to which this tree is subject; but in this case, as well as with the other trees or crops referred to, it is not possible in the space of this volume to do more than allude to a small part of the more important.

PINE.

Pine Beetle. *Hylurgus piniperda*, Linn.

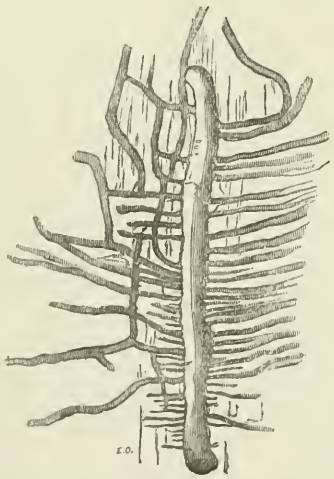
1, 2, Pine shoots pierced by beetles, in section; 3, 4, Pine Beetle, nat. size and magnified; *e e*, jaws; *f g*, chin, with feelers, &c.

The Pine Beetle (the "Wood Gardener" or "Forester" as it is called in Germany, from its effective powers of pruning) is injurious to some extent to standing Pine timber by means of its maggot-burrowings beneath the bark, both of stems and branches; but as they appear rarely to select healthy trees if sickly ones are at hand, and chiefly frequent fallen wood, felled trunks, or dead or decaying trees and branches for breeding purposes, this part of their workings is chiefly hurtful as being the means of continuing infestation.

The great mischief is caused by the beetles after they have left the breeding galleries beneath the bark; then they are sometimes very destructive, and especially to young Pine plantations, by boring through the side of the tender shoots and eating their way for an inch or two or more along the pith. The injury to side shoots by this means is considerable, but in the case of the leading shoot being thus lost the tree often becomes bushy-headed, its growth is retarded, and its ultimate value is reduced.

The Pine Beetles are of the size figured (p. 242), and of the shape given more clearly in the magnified figure, of a pitchy colour when mature, but paler previously, rough, punctured, with longish hairs, and furnished with strong jaws. The wing-cases are rounded down at the sides, and cover a pair of wings capable of strong flight.

The female appears in April or May, and begins her operations by boring a hole through the bark, beneath which she forms a gallery or tunnel of a little more than her own width;



Tunnellings of Pine Beetle.

along each side of this she lays her eggs, from which the larvæ or maggots soon hatch, and each larva eats its way forward beneath the bark, thus forming a series of burrows, gradually getting larger towards the extremities, sometimes running nearly at right angles with the first (or mother beetle's) tunnel, at others bending in various directions, as here figured. The burrows are eaten out of the under side of the bark, but often show just a trace of working on the outside of the wood lying against it. The above figure shows one mother gallery, with

the maggot galleries running from it, but they may be found in such great numbers beneath infested bark that a large space of wood and bark is separated by the tunnellings.

The maggots are about a quarter of an inch long, legless and fleshy, and largest in the rings behind the head, which is of an ochreous colour; the rest of the maggot is whitish, with a light ochreous tint towards the tail. The maggots turn to pupæ at the end of their tunnels, from which the beetles are developed in July and August. Then they pierce a little round hole through the bark, at the end of their burrow, come out through it, and fly to the neighbouring trees, where they may be found in September in great numbers, boring into the young shoots and injuring them, as above mentioned.

Prevention and Remedies.—These are entirely based on knowledge of the habits of the beetle, and the difference between the two methods of attack should be kept clearly in mind.

The beetles tunnel along portions of the pith of the young shoots for food and shelter, not for breeding purposes. For the latter, although they sometimes propagate beneath the bark of growing as well as felled timber, yet for the most part they choose situations for the maggot-nurseries where the sap is not in healthy flow; that is, sickly standing trees, or else felled trunks or branches before the juices between the bark and wood are completely dried up.

Relatively to injury to the shoots:—In observations sent me by Mr. Henderson, from Tullamore, King's County, Ireland, in 1881, he noted on October 22nd that the beetles were then boring up the centres of the shoots. Most of the shoots were then quite green, and until closely examined it was not easy to detect the holes by which the beetles entered. Some of the shoots, however, were just beginning to show a yellow tint, and would die and fall off, in stormy weather, in the following spring or summer.

Mr. Robert Coupar (Forester), writing from Colenden, Stormontfield, N.B., mentioned that sometimes the beetles only just attack the shoots slightly at the base of the buds, and then the injury is small; but sometimes, by beginning boring close below the then present year's growth, or piercing along the young shoots themselves, the leaves are only partially developed, and from their stumpy appearance the attack may be observed at a considerable distance. "The attack may be found going on from early summer, and when once the shoots are tunnelled they are easily broken off by the wind."

At the date of writing (Nov. 28th) large numbers were to be

found lying about in the wood, many empty; also many with beetles in them, and during winter *Pine Beetles may be found hybernating in them*, or amongst the "fog" or forest rubbish.

Clearing away the infested shoots, *off the trees* in summer, or *from beneath them* in winter, is one means of preventing recurrence of attack, but not so easily carried out as might be supposed.

Mr. Coupar remarked:—"When young plantations of about six to twelve years' old are attacked, they may be gone over, say in June or July, and the infested shoots picked off; but (as these beetles are very wary) at a touch to the branch they back out of their tunnels and fall to the ground. Therefore, after collecting attacked shoots into a basket, the work may prove to have been to no purpose, and on arrival at the end of your journey you may find the shoots quite clear of beetles, these having all escaped!"

Mr. Henderson, above quoted, noted that "when the attack is observed on young trees, the best way of safely getting rid of it is to cut off the shoot below the undermost small hole to be seen on the shoot. The person cutting them should have a small bag, something like the planting-bag used for carrying small trees during planting operations, and into this bag he can put the cuttings, and when filled carry them to the outside or an open part of the wood, and burn them at once."

Removal of infested shoots, as above mentioned, from which the beetles *come out* to propagate, is important; but almost more important yet is removal of all thinnings, pieces of felled Pine or other Pine rubbish, beneath the bark of which the beetles will tunnel and there form their maggot-nurseries.

Mr. W. McCorquodale, of Scone, N.B. (well-known for his skill in forestry), laid down:—"When young Fir plantations are thinned, all the brush ought to be at once removed or burnt on the ground, as the beetle propagates in the decaying branches in legions. They ascend the standing trees, and commit extensive ravages. When Fir thinnings are carted from the plantations, it is a very common practice to dress the bark off, to lighten the carriage in transit to market.

"The dressing-off of the bark should not be permitted within the plantation; in a year after the ground round these heaps of bark may be seen covered with brown shoots blown from the growing trees, bored by the beetles which the heaps have nurtured."

Mr. Henderson also noted that at Tullamore, in the case of a young Pine wood, where most of the thinnings were taken away, but some piles of them left, near every pile the ravages of the beetle were visible; and, even where only one of the felled

trees was lying, that three or four of the young trees near were attacked in the young shoots.

This habit may be used very serviceably for trapping purposes, as noted by Mr. Robert Coupar, before mentioned in observations regarding preventive measures:—"The most serviceable (and a quite practicable) way is to set a quantity of 'beetle-traps,' which are laid about in the plantation, and are thus arranged:—Cut in the autumn a quantity of young Scots Pine tops (thinning off all the branches, which makes them more convenient to handle). Lay these props about in the young plantations, or up against the lower part of the standing trees, so that the under side *will not rest on the ground*, because the beetles do not lay their eggs where the trees are lying amongst damp or wet.

"When the time for egg-laying comes the parent beetles select these pieces of Pine, and by collecting them again (say in the month of June or sometimes earlier) you will have under the bark a great number of these destructive pests.

"This is a most practicable way, as it answers for plantations of all ages. As I stated before, I have found in old plantations (from 60 to 100 years of age and over) that, when large branches decline and growth becomes languid, then these beetles select them to lay their eggs in, as also in decaying standing trees. Again, no decaying trees should be allowed to lie, and thinnings should be cleared up as soon as possible."

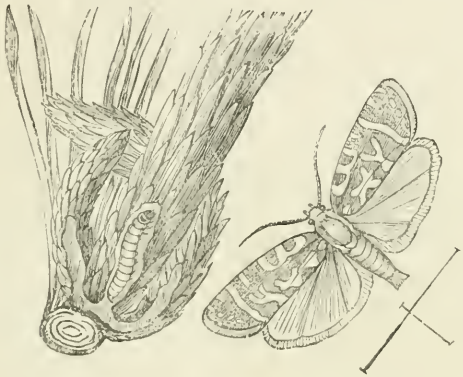
Mr. Coupar noted in May, with regard to a large quantity of young Scots Pine, which had been cut down in the course of thinning, that at the time of writing the Pine Beetles were very busy indeed laying their eggs. These Pines had been cut down in the previous January, and the note confirms previous observation of these beetles choosing, for egg-laying, trees which have been only lately felled, and which consequently have neither the full flow of sap of the living trees, nor yet have laid long enough for the inner bark to be exhausted.

Pine-bud Tortrix Moth.

Orthotænia turionana, Curtis; *Retinia turionana*, Hübn.

The caterpillars of the Pine-bud Moth are injurious to Scotch Fir, Silver Fir, and various species of Pine, by feeding in the buds, and especially inside the terminal bud of the leading shoot. By this means, as some of the buds are killed and the leading shoot is often destroyed and its place taken by a side one, the uniform growth of the branches is interfered with.

The description given of the mode of life of this Tortrix Moth, the *O. turionana* of Curtis and Stephens,* by Prof. Westwood, is as follows :—" The larvæ are hatched from the eggs deposited by the females in July, in the course of ten or twelve days, when they immediately penetrate into the bud, the centre of which they destroy; and, descending through the heart of the bud to its base, they then attack the adjoining



Shoots injured by caterpillars of Tortrix. Pine-bud Tortrix, *R. turionana*, magnified, with lines showing natural size.

buds in the same manner; not only destroying the central shoot, and thus preventing the straight and elegant growth of the branches, but also killing the side buds, and even penetrating into the turpentine tubercles with which some of these Firs abound. By the end of October the caterpillar is feasting on the interior of the largest middle bud, beginning below that which was formed for the following year, in which it spends the winter, renewing its ravages in the spring." . . " The caterpillar is full grown about the end of June, when it descends to the lower part of the burrow which it has formed in the bud, and is there transformed into a shining chestnut-brown chrysalis, which, like those of most internal-feeding species, has the head furnished with a small point between the eyes, and the segments of the abdomen armed with double rows of very fine points directed backwards, enabling the insect to move itself about in its retreat."—(J. O. W.)

When full grown the caterpillars are usually about half an inch long, reddish or purplish brown, with brown or black head, and with dark bands on the segments; or with one dark or black band across the segment next to the head. After changing to the chrysalis state as mentioned above, the moth comes out from these commonly in July, and then may be

* See 'Gardener's Chronicle' for 1850, p. 692.

seen resting on the Pine stems, which it somewhat resembles in colour. The fore wings are from half an inch to a little less than an inch in expanse, and of rusty red colour (sometimes of a darker tint or of a tawny orange), varied with irregular silvery markings (see figure, p. 247). The hinder wings are whitish grey in the male, darker towards the edge, which has a white fringe; in the female they are grey throughout.

In 1882 I had detailed observations and specimens of an attack to Scotch Pine, corresponding with this of the *O. turionana*, sent me by Mr. Coupar (Forester), of Colenden, Scone, which I noted at length in my 'Report of Injurious Insects' for that year, otherwise the attack has rarely come under my observation. Mr. Coupar noted, with regard to extent of injury, that the infestation did much harm in young Fir woods; and also that the damage caused by these caterpillars might be easily known by the straggling appearance and loss of regularity of growth of the trees, from the injury to the buds and leading shoots.

The Pine-bud Moth (above mentioned) and the Pine-shoot Moth, *Retinia buoliana* (mentioned below), which are species of *Tortrix*, resemble each other in so many points of appearance and habits that it is not always possible to ascertain which of the two species is referred to in observations of methods of attack. From the descriptions here quoted it appears that the *R. turionana* is the smallest of the two moths, the caterpillars of which feed chiefly inside the buds, the feeding-season being both in autumn and in the following spring. The caterpillar of the *R. buoliana*, which is stated to be the most injurious of the two kinds, feeds mainly in the spring of the year on the growing shoots, under a shelter of threads of its own spinning and hardened turpentine.

Pine-shoot Tortrix Moth. *Retinia buoliana.*

These Moths are to be found during July about young Pine trees of various kinds.

The female lays her eggs between the buds at the ends of the boughs. The caterpillars, which hatch late in the summer, gnaw these so as to cause a flow of turpentine that gives them a slight coating, and here the caterpillars hybernate. Their operations are first noticeable in the following spring, when the trees begin their growth, after which the grubs attack the shoots nearest, or one side of them, and are to be found sheltered under a kind of web and the turpentine that flows from the wound.

The caterpillars are at first of a dark brown, which changes to a lighter colour afterwards; the small head and a band on

the segment next to it are of a shining black. These are to be found from September to May, and on ceasing to feed they change (at the same spot) to chrysalids of a dirty brownish yellow, blunt at the tail, and furnished on the abdomen with prickle-like processes pointing backwards. They are to be found in June in the young shoots, and after lying in this state for four weeks the moths appear.

These are rather larger than the foregoing species. The upper wings are reddish yellow, changing to a darker tint at the tip and marked with light stripes from the base, and silvery spots and transverse wavy lines; the hinder wings are blackish grey, with a yellow tint, and yellow-grey fringes. In the dusk of the evening they swarm round the tops of the young Pines out of which they have hatched, but by day they rest and are not readily seen, from their similarity in colour to the withered shoots of which they have been the cause.

This species is common wherever Pine trees are to be found, from the north to the south of Europe.

The infested trees are easily known by the distorted shoots; those that have been injured (and the growth consequently checked) on one side turn downwards, gradually lengthening, till after a while the shoot raises itself upwards at the tip and takes a straight course again; but meanwhile a knee has been formed, and a crippled state given to the branch. The shoots that have been destroyed turn brown and die on the tree, many break off at the bend, and stumpy growths, from the number of buds thrown into unnatural development, entirely spoil the characteristic appearance of the tree.—('Prak. Insecten-Kunde.')

Prevention and Remedies.—Where the state of the buds or shoots show the caterpillar (or chrysalis) to be present, these should be carefully removed, so as not to injure the remaining shoots, and all these infested pieces should be burnt. This will lessen the amount of future attack, and the earlier it can be done in the season the better, so as to push on a good growth in the healthy shoots that are left, by means of the sap that otherwise would have been shared with the infested growths.

From the fact of the moths being sometimes noticeable in large numbers flying in the evening over the infested trees, it is worth consideration whether washings (see Index), such as would make a light sticky coating over the buds for the short time the moths were about in large numbers, and which would lodge between them, and so especially protect the spot which the Pine-shoot Tortrix selects for deposit of its eggs, would not be of service.

Pine Sawfly. *Lophyrus pini*, Curtis.

Pine Sawfly, pupa, and larva, magnified. Pine-leaves injured by Sawfly.

The caterpillars of this Sawfly cause great damage to Pines, and especially to young Scotch Fir woods, by feeding on the leaves. In some cases they scoop away the sides of the leaf, leaving only the midrib; in others, beginning at the tip, they eat the leaves almost down to the sheath. They also feed on the bark of the young shoots, and, as they have voracious appetites and appear in companies, the mischief they do is enormous, and, unless checked by treatment or weather, is continued year after year by successive generations over large areas, sometimes extending to two thousand acres or more of plantation.

The Sawflies appear early in summer, when the female inserts her eggs in the Pine leaves by cutting a slit along a leaf with her saw-like ovipositor and laying a few eggs in the opening, which she covers with a resinous material scraped from the leaves, repeating the operation until all the eggs have been laid. The caterpillars hatch in about three weeks, and, like others of the genus *Lophyrus*, are 22-footed. They have a pair of claw-like feet on each of the three segments immediately behind the head, the next segment is footless; the succeeding seven segments have each a pair of sucker-feet (or "prolegs"), and the tail is also furnished with a pair, known as the "caudal proleg." The colour varies much with age, health, and weather; at first the grub is green, paler or whitish beneath, with a brownish yellow head, and black sucker-feet; when full grown it has a rusty brown head, dark forehead, and black jaws and eyes; it has an interrupted

black line along each side formed of a patch of black dots on each segment; the true feet are black; the sucker-feet are yellow, with a black line at the base; when full grown it is about an inch long.

They feed for eight weeks, and then form cocoons in the moss and leaves or decayed matter beneath the tree upon which they feed, or on the leaves, or in crannies of the bark.

This cocoon is oval, a quarter of an inch or somewhat more in length, and small for the size of the caterpillar (which lies doubled on itself within), and is remarkable for the hard, compact nature of its exterior.

"The colour of specimens spun under moss is commonly of a dull brown, and of those fastened to the tree either a silky ash-grey, dirty white, or with a yellow tinge; a clean white and a rusty red (the latter commonly with a woolly surface) occur sometimes, but only occasionally."—(Th. H.)

The time taken for development varies; in some cases the caterpillar remains unchanged for nine months in the cocoon, sometimes even for a longer time before it turns to the pupa (figured above, removed from the cocoon); but the appearance of perfect Sawflies may be looked for early in the summer. Sometimes, however, there is a second brood, of which the Sawflies appear in the autumn. In 1884 Mr. W. E. Cattley, of Ederton, Ross-shire, noted on July 30th, regarding the disappearance of a widespread attack of Sawfly caterpillars on his Fir plantations:—"I was absent from home for a fortnight, and on my return the caterpillars had completely disappeared; no doubt they had spun and hidden somewhere. But where?" Careful search both by Mr. Cattley and his men did not find out at the time, but later on Mr. Cattley reported:—"On September 6th some of the Sawflies had come out (of the summer cocoons), the males smaller and sparer than the females, with broad comb-like antennæ and black in colour; and after these had come out I found *scores of empty cases not in the ground, but in the rank growth of Heather.*"

He also noted, on the 16th of October, with regard to difference in method of feeding of the earlier and later brood,—"They now feed on the shoots of the year which the spring brood avoided."

These observations of Mr. Cattley are of considerable interest, as giving an example of habits of the Pine Sawfly in the north of Scotland agreeing with those recorded in Germany, by Dr. Bernard Altum, when two broods occur in one season:—"The Sawflies are found at two different times in the year—in April and July. Larvæ are found in May and June, when they feed on the Pine leaves of the previous year. They turn to pupæ in the beginning of July, and after two or

three weeks develop into Sawflies (or in August or September). The larvæ from these live on the Pine leaves of the present season, and (quite differently to the first set, which form their cocoons on Pine leaves, &c.) these go into cocoon in the earth. Here the caterpillars lie in cocoon the whole winter through without becoming pupæ until spring, a period of nine months for the metamorphoses which happened so quickly previously."

"However, *all* winter cocoons do not belong to the caterpillars of the second generation; it often happens that there is *only one generation*, and the caterpillars of this hybernate in the ground in cocoons."*

The male and female differ from each other both in colour and size; the male is black, with four transparent iridescent wings, which are about half an inch in expanse, and the feather-like rays of the horns are more developed than in the female. The colour of the female is whitish, with black head, breast, and horns; a black patch on the back of the abdomen, and a black patch or spots between the wings, which are about three-quarters of an inch in their expanse, and iridescent with purple and green, varied with yellow, like those of the male.—('Die Blattwespen,' 'Naturgeschichte der Schädlichen Insecten,' 'Stephen's Illus. Brit. Ent.,' &c.)

Prevention and Remedies. — *Clearing away cocoons from under infested trees during the winter* is the best method of preventing attack in the ensuing season.

A large proportion of the Pine Sawfly caterpillars which leave the shoots in autumn bury themselves (as mentioned above) in the dry leaves, Moss, or decayed rubbish beneath the tree, and are stated for the most part to form their cocoons near the stem of the tree, where they are sometimes to be found lying together in masses as large as a man's fist.

"The ground underneath Scots Fir trees is generally bare, and covered only with the fallen leaves and tree *débris;* so that it is an easy matter to examine the surface of the ground near the base of the trees, and, if found infested with cocoons, to scrape it together and *burn* it in small heaps, so as to destroy the insects.

"Another plan might be useful; that is, turn over with a spade the loose surface-soil and tree *débris* containing the cocoons, and give it a heavy beat with the back of the spade, thus smashing and destroying the cocoons.

"However nothing is so effective as collecting the surface-soil and rubbish into small heaps, and burning or charring it. Even where the surface is covered with rough herbage or

* 'Forst Zoologie,' von Dr. B. Altum; "Insecten," Part ii., p. 269.

Heather, this is the best plan, as the rough material will all help the *charring* of the soil, and *burning* of the cocoons." (M. D.)

With regard to clearing caterpillars off the trees, the following method was found successful on a plantation of about eighty acres near Forres, which was infested by the larva of a Sawfly :—

"When the caterpillars were first noticed, a careful man was provided with a pair of strong gloves, with directions to examine the state of the trees daily, and when he found the caterpillars—which are generally in clusters—to destroy them by *infolding the branch on which they were feeding in the gloved hand and pressing it firmly*. The caterpillars (which had not appeared in the whole of the plantation, but in great numbers in some parts of it) were thus prevented from doing any great amount of damage."—(D. S.)

Near Dunkeld (where Sawflies had been very injurious for several seasons previous to 1879, on a young plantation of two thousand acres of Scots Fir), an experiment was tried on a small plantation of twenty acres, five miles distant from any other Scots Fir wood, which, up to the date of the observations sent, had proved successful. The plan adopted was to send a number of boys through the plantation, each furnished with a small vessel containing naphtha, and a brush roughly made of feathers, with which the clusters of larvæ were slightly sprinkled or touched, when they immediately fell down, and by this means the plantation was almost cleared.—(J. M'G.)

In the case of a bad attack of Pine-leaf Caterpillars in Roxburghshire, after various means of destroying them had failed,—such as dusting the trees with quick-lime,—the use of hellebore in solution, applied by means of the syringe, was found a deadly application to the caterpillar and an effective cure.—(C. Y. M.)

In the case of larger trees, much good may be done by shaking down the caterpillars and destroying them before they have time to creep away. They fall in great numbers (especially when chilled and slightly torpid in the morning) on the tree being shaken or jarred; and in German forestry it has been found that one man to shake the tree, accompanied by two women or children with a sheet for the caterpillars to fall on, from which they can be collected and destroyed, can clear fifteen trees of twenty-five years' old before nine o'clock in the morning.—(Th. H.) If some fresh Pine boughs are strewed under the trees before they are shaken, the fallen caterpillars will collect immediately on the sprays, and may be trampled on, or more conveniently shaken on to the cloths to be destroyed than by simply letting them drop on the cloths from the tree.

It is also desirable, before shaking, to put a band of some nature that the caterpillars will not cross on the ground at the foot of the tree, to keep all that may have escaped from making good their return up the trunk.

Quick-lime would answer this purpose, or gas-lime; or a hay-band (or pieces of any old rags twisted together into a rope) well tarred or soaked in a mixture of tar and oil that would keep wet and sticky for some time, would be a sure preventive of traffic of the caterpillars across it.

When the caterpillars have consumed the leafage on one tree, they migrate to another; and where tracts of forest are affected it has been advised to dig ditches not less than two feet deep and two feet broad, with the sides as perpendicular as possible. Looking at the clinging powers of the caterpillars, it does *not* seem likely that this plan would do more than delay progress, and also afford a clear space where the caterpillars, when they occur in the myriads described by Hartig and Kollar in the German Pine forests, might be duly dealt with by regular watchers; but, generally speaking, a broad band of something which they would not cross, laid on the ground, appears a more practicable remedy.

Sand or ashes, or dry earth, well sprinkled with paraffin and water, would probably check the onward progress more effectually at less cost; or a band of fresh gas-lime would be effective. Quick-lime would be of little use in this case, as something is needed of which the effects would last for at least a few days.

When infested and uninfested trees are mixed together, it may be worth while to isolate such as have not been attacked. Save where the boughs touch, the caterpillars can only reach them by crawling up the trunk, and a large number might be protected at a small expense by placing rings of any deterrent the forester might choose at the lowest part of the trunk, or on the ground round it. A band about a foot wide of fish-oil soft-soap, mixed to a thick consistency and laid on with a large brush, would cost little beyond the wages of the operator, and probably be a preventive.

Something may be done just for a few small trees by picking cocoons off the leaves, or clearing them from crevices on the bark, or by removing the leaves that have eggs laid in them; but these operations are not practicable on a large scale.

Ungenial weather acts powerfully on this insect.—In the autumn of 1880 it was noted that the first frosts, coming suddenly, destroyed many of the caterpillars that still remained on the trees at Earlston, in the south of Scotland, and the absence of the Sawflies from the Athol forests, and also

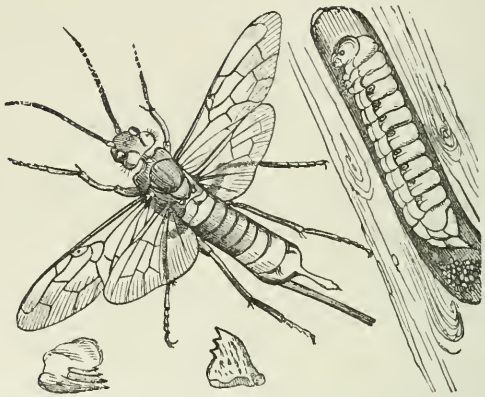
their almost total disappearance from the young plantations in the neighbourhood of Beauly in 1880, after having ravaged the young Fir woods for five or six years until acres were completely stripped of their leaves, is attributed to the low temperature of the preceding summer. Looking at this susceptibility of the caterpillars to injury from wet and cold, in their young state and when they are changing their skins, it suggests that something might be done in attack on trees in nursery ground, and on limited areas, by syringing. The kind of engine used in Hop-grounds with a double hose would be applicable to the work, and, where water was at hand, the rapid clearing it would be almost certain to effect would be worth a trial.

We have some help in keeping down this pest both from birds and the smaller Mammalia. Woodpeckers of various kinds, Jays, Cuckoos, Titmice, Hedgesparrows, and Swallows, are of service in destroying the perfect Sawflies, and also the cocoons with the contained caterpillar; but they shun continuous attack on the caterpillars on the trees, and diet on them appears to be prejudicial to the nestlings. Amongst four-footed enemies the Field Mouse and the Short-tailed Field Mouse (Field Vole), both of which when driven by hunger are carnivorous, are stated to destroy cocoons lying beneath the Moss, together with their contents. Squirrels are not less destructive, as many as a hundred of these spun-up caterpillars having been taken from the stomach of a single specimen; but they will not eat the caterpillars whilst feeding on the leaves.—(Th. H.)

The surest methods of prevention of these pests, however, appear to be in taking advantage of their habits of forming their cocoons in large numbers beneath their food-trees, and of falling from the branches on a sharp shake being given to the tree.

Note.—I have also had observations, with specimens, during this year, of much injury being done by the caterpillars of the *Lophyrus rufus* of Klug on three or four thousand acres of young Scotch Fir in Argyleshire. These caterpillars are of a greenish, dusky grey, with black heads, a fine lighter line along the back, and a dusky line above the spiracles. The abdominal sucker-feet and abdomen below, yellow-green. The specimens sent me on the 10th of June had spun their cocoons by the 23rd. The flies may be looked for from August onwards. The females are reddish; the males black, with abdomen beneath and legs, red. It was observed that trees ten feet high were not so seriously attacked as those from two to six feet high.

Giant Sirex ("Wood Wasp"). *Sirex gigas*, Linn.



Female "Wood Wasp" and maggot. Jaw of maggot, with four sharp, narrow teeth; and jaw of fly, with three broader teeth, both magnified.

The splendid insect figured above is not usually credited with doing much mischief in England, but from my own observation I incline to think that this "Fir-wood Wasp," as it is called in Germany (as well as another kind, the Steel Blue Sirex or *Sirex juvencus*), is more often at work than is supposed. The injury of the *S. gigas* is caused by the large maggots boring galleries in the solid Fir timber.

The female *Sirex* lays her eggs in various kinds of Pine—Scotch Fir, Silver Fir, and Spruce—which, though not decayed, are not in full health; such, for instance, as trees past their prime, or that have been uprooted, or broken by wind or accidents, or are sickly from any other cause; and it has been considered, by some observers, that even an insignificant local injury to the tree may afford a point for attack; that the females lay their eggs on such damaged spots, from which the brood spreads, and thus in a few years an otherwise healthy trunk is destroyed. The eggs are also stated to be deposited in felled Fir trunks left lying in the woods.

The female (as figured above) is furnished with a long ovipositor, by means of which she bores a hole through the bark of the stem of the tree for the deposit of her eggs.

The maggots from these are whitish, soft, and cylindrical, with a scaly head armed with strong jaws; a blunt point on the tail-segment, and they have three pairs of very minute feet. These larvæ feed in the solid timber, and are full grown in about seven weeks; and then or later (for how long the larval and pupal state last seems uncertain) they change to

chrysalids in the tree. The pupa resembles the perfect insect lying still, soft, and white, with the limbs laid along the breast and body.

The further change to the complete insect may occur in a month, but if the maggot has not turned to the chrysalis till autumn the fly will not appear till the following summer, or even a much later period.

The female *Sirex* is usually an inch and a half long, cylindrical, and with the head and the rest of the body of the same diameter. The colour is black, banded with yellow on the first two rings of the abdomen (the first of which is brownish at the base). The last three rings of the abdomen are also yellow, with some amount of brownish at the base of the last segment. There is also a yellow spot on each side of the head. The abdomen has a strong blunt point at the tip, and underneath it is furnished with the ovipositor, which is long and black, and lies in the yellow sheath shown in the figure (p. 256). The thighs are black, the shanks and feet yellow, and the four large membranous wings are of a brownish yellow.

The male is smaller, with the abdomen flatter and yellowish, excepting the first segment, which, as well as the last segment (or end of the tail) and its appendage, is black. The hind pair of shanks and feet are black or dusky; pale, or with yellow rings at the base. The horns are yellow; those of the male are nearly as long as the body, those of the female are rather more than half that length.

Prevention and Remedies.—The best methods of prevention are to clear away trees that are in a condition to attract attack—such as trees that have been injured by accident or ill-treatment, or that are weakened by disease or attacks of other insects, and also those that have been blown over or that have been felled, as the *Sirex* lays its eggs in felled as well as in standing timber.

Any trees which are found to be infested (either by the *Sirex* being seen escaping, or by the large holes in the trunk showing the escape to have taken place) should be felled and disposed of according to their condition, so as to stop further spread of the insect from them.

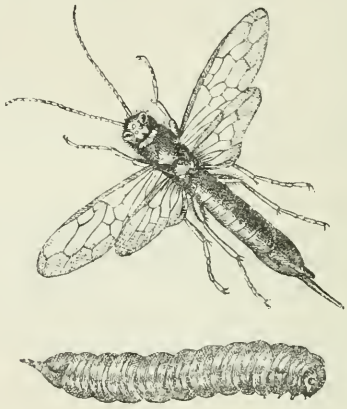
If they can be taken to the saw-pit and converted to any rough use it is best, for thus the infested parts may be cut off and burnt, and the sound timber preserved; but if this cannot be managed, something should be done, both with trees in this state and felled trunks lying in the woods, to prevent the insects escaping.

If nothing else occurred the tree might be split for firewood

to be used at once, or it would be worth while to heap up any rubbish near, over the trunk and char the outside.

Sometimes the insects appear suddenly in great numbers. I have seen twelve to twenty specimens captured in a few hours, as they came out of one Larch trunk lying by a Fir plantation in West Gloucestershire (Ed.); and in such a case a child with a net could easily catch and kill them. Generally, however, they appear singly or a few at a time, often over a period of several years from one trunk.

"Steel Blue" or "Common" Sirex. *Sirex juvencus*, Linn.



Common Sirex and maggot.

The Steel Blue or Common Sirex is a most variable insect, both in its size and colouring. The female is commonly blue-black, with rusty red thighs, and reddish shanks and feet; black horns, and somewhat transparent brownish wings, with rusty veins and spot on the fore edge. The male blue-black; abdomen, with margin of the third and the whole of the four following segments, red; the hinder shanks and feet dilated and compressed, and dark blue.

Both sexes, however, vary in amount of red or black on the legs; also sometimes the prevailing blue tint is varied by greenish colour, and also, in the case of the male, the abdomen is sometimes bright red, excepting the two rings at the base; or again, the six lowest joints of the horns may be red, and many other small differences of colouring also occur in different specimens.*

* For detailed descriptions of British species of *Sirex*, see Stephens' Illus. of Brit. Ent. Vol. 7 (Mandibulata), pp. 113—116.

The size varies from about half an inch to an inch and a third or an inch and a half in length, and from about three-quarters of an inch to a little above two inches in the spread of the wings. This variation appears to me to be much influenced by the conditions of the maggots having been favourable or otherwise, for amongst specimens sent me during 1889 some fine females, measuring quite the fullest length given above, were sent me from an old Silver Fir, where everything must have been suitable for growth; whilst amongst specimens from some buried wood used for supporting drain-pipes I had a male just under half an inch long, and a female five-eighths of an inch long, including the ovipositor.

The habits of these two kinds of *Sirex* (that is, of the *S. juvencus* and *S. gigas*) appear to be almost exactly similar. The females pierce into the bark of the Larch, Silver Fir, or other kind of Conifer that they may attack (standing or felled, as the case may be), and with their strong ovipositors deposit their eggs, one at a time, in the soft wood immediately beneath, and in each case the maggots are whitish, soft, and cylindrical, with scaly heads furnished with strong jaws. The three pairs of feet are very small, and at the rounded tail-extremity (above) there is a blunt point or spine; they feed in the solid timber, causing great injury by their large borings.

In an estimate sent me in 1889, by Mr. W. Hodgson, A.L.S., of Workington, Cumberland, of loss caused by damage from maggots of *Sirex juvencus* (of which specimens were identified) to some Silver Fir trees at Gilgarron, near Whitehaven, he reported as follows:—

The number of Silver Firs on the grounds is slightly in excess of forty trees, of over seventy years' growth, varying in bulk from twenty to forty cubic feet per tree. This will give on the whole a trifle over 1200 cubic feet of timber irretrievably damaged, which, estimated at sixpence per foot, represents a loss of £30 in money value, to say nothing of the injury done to the appearance of the woods and coppices.—(W. H.)

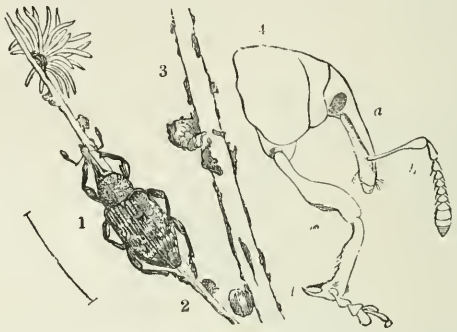
With regard to prevention of Sirex-attack to old Silver Fir trees, it is possible that something might be done to protect favourite or specimen trees by finding whether from age or other circumstances the outer bark was flaking off in the way described in Selby's 'British Forest Trees,' p. 472, leaving a newly-exposed cuticle.

Where the thin under-bark is thus exposed, it would presumably be particularly inviting to Sirex-attack, and for a few favourite trees it would be worth while to try the effect of a good smearing with soft-soap preparation, or any deterrent which would be likely to protect the tree (where the bark had scaled off) during the time when the "Timber Wasps" are

about in summer, and would gradually wash off without harming the surface to which it was applied.

For general purposes, the only reasonably practical way of preventing spread of Sirex-infestation appears to be as previously mentioned, timely removal of infested timber, whether in the form of standing or felled trees, or fallen trees, or infested limbs.

Pine Weevil. *Hylobius abietis*, Linn.



1, Pine Weevil, magnified: line showing nat. length (snout included); 2, 3, Larch twigs injured by weevils; 4, head, with snout and horn and fore leg, magnified.

The Pine Weevil is injurious to Scotch Fir, Spruce, Larch, and some others of the Coniferæ, by feeding on the tender bark of the young shoots. It mainly attacks young trees, especially plantations formed on ground from which a crop of old Fir has recently been removed, and eats away the bark of the stems, sometimes completely stripping them upwards. It also eats the bark of the shoots, and destroys the bud; and, in the Larch, it gnaws at the base of the leaves so as to render the shoots bare.

The beetles appear early in the summer, sometimes in May, but chiefly in June and July. In unfavourable weather they remain under shelter of the leafage, but when it is warm and sunny they are more active, and pairing then takes place.

The females deposit their eggs, which are transparent and whitish, in rifts of the bark, in logs, root-stocks, stumps of felled trees, and on exposed parts of roots.

The maggot hatches in two or three weeks, and may be found from June onwards throughout the winter. When full grown it is about half an inch long, fleshy and white, with a brown head, which, as well as some portions of the maggot,

is beset with bristles. It is either legless, or with mere indications of legs on the three segments behind the head, and in general shape resembles other weevil-maggots (excepting that the three segments above mentioned are so much enlarged as to give a swollen appearance to this part of the maggot, which is also much wrinkled transversely), for figs. of which see references to "Weevil" in Index.

The maggots form more or less winding galleries in the soft wood beneath the bark, which gradually increase in size with the growth of the maggot, and, following the course of the root, go down to some depth below the surface. These galleries are gradually filled with the results of the wood-gnawings ("worm-meal") left by the maggot, and at the extremity of the boring there is a cocoon-like accumulation of chips forming a nest for the pupa.

The pupæ resemble the beetles in shape, but with the legs and partially developed wings and wing-cases, and also the long snout or proboscis, folded under them; the rings of the abdomen are slightly saw-like at the sides. These pupæ are to be found in spring in their cocoon-like nests, and in this state they lie quiet for about four weeks, when the young beetles develop and come out, whilst some of the beetles of the previous year that have hybernated are again to be found. These latter have passed the winter in Moss, or fallen leafage and twigs, or even in holes in the earth, or roots under the trees, or similar sheltering places, and may be known from the freshly-developed beetles by their more faded and worn appearance.

The beetles are about half an inch in length, of a dull pitchy black, with some yellowish hairs on the head and on the body behind the head, which is also thickly roughened with small pits or wrinkles. The wing-cases are rounded at the sides, and bluntly pointed at the tail (so as to be somewhat boat-shaped), with lines of oval or squarish punctures and the surface rough; they are also variegated with irregular transverse bands of spots of yellowish hairs. The legs are black. The beetle is especially distinguished by its long snout or proboscis, with elbowed horns, of which the long lowest joint fits into a hollow formed for its reception in the side of the proboscis (see fig. magnified, p. 260).

Prevention and Remedies.—One of the chief points to be observed in the habits of this beetle is that it frequents forest clearings, that is, spots where Fir trees, few or many, have recently been felled. Here it harbours under pieces of bark, broken wood, &c., and lays its eggs on the logs, stumps, and exposed roots.

It is therefore desirable that all such points of attraction

should be got rid of out of the wood. There is no occasion that anything should be wasted, for the fragments that are only useful as fire-wood may be burnt long before any eggs laid in them can develop through all their transformations, but they should *not* remain in the woods. Fragments of roots left in the ground should be thoroughly covered with at least six inches of earth, and *no* logs (which are an especial haunt of the beetle for oviposition) should be left about, unless some of them, or of the fragments of bark, are used for traps. This has been found practically useful in German forestry, and if these traps were regularly examined, and the contents destroyed, they would probably be an excellent means of getting rid of many of the weevils, which will frequent a clearing so long as it is in progress, and the air pervaded with the scent of turpentine.

Bark-traps are made by laying pieces of bark with the inner side downwards on the ground. Pine bark is said to answer better than Spruce, as it remains fresh longer. The pieces should be well weighted down with stones, and examined early or late in the day. The number of beetles caught is greatest in dull weather or during soft rain.

Log-traps make a good decoy to attract the female beetle to lay her eggs; in this plan thick pieces of logs with bark on them are partly buried in the ground. The beetles resort to them, feed on the sap, and lay in them, and numbers of beetles may thus be caught and the brood from the eggs got rid of afterwards by burning the logs when convenient.

Brush-traps are made of Pine or Spruce twigs, tied together in bundles, about the size of a Birch-broom; these are scattered about infested spots, and attract many weevils, which may be easily shaken out of them and destroyed.

It cannot be too strongly insisted on that all such places for propagation as dying trees, waste timber, broken bark, stocks, roots, &c., that cannot be removed, buried, or utilised as traps, should be carefully gathered together and *burnt*.

The neighbourhood of forest saw-pits should be similarly attended to, and any logs of felled timber, whether in or out of the woods, should be observed relatively to their serving for breeding-places. In the summer the beetles may be found pairing on planks, cleft timber, &c., far from woods.

It is, however, not worth while (unless special circumstances should point out otherwise) to meddle with rubbish under Pine trees, such as Moss, dry Pine needles, small twigs, and such like; the weevil does not feed on these, and does not lay in them (for they would not afford food to the maggot); it only shelters itself in them for the winter, and the small number that would be destroyed would scarcely repay the labour.

The second and most important point in the habits of the weevil is that of attacking young plantations, and especially those that have been formed on recently cleared Fir forest lands. It has been found that on land cleared of Scots Pine, and planted within four years with Coniferæ, that there would be few remaining uninjured two years after.

The following method of treatment has been thoroughly successful:—

After the Pine crop is cut and cleared the ground is properly enclosed, so as to exclude stock of all kinds, and, if required, it is drained. The ground is permitted to rest the first summer for the purpose of getting up all herbage as strongly as possible, and in dry spring weather the whole is burned, so as to destroy the eggs and food of the beetle, and as far as may be stamp it out. After this the ground should be planted with strong two years' transplanted plants. After each young tree is planted a layer of earth is laid round about two inches in thickness and eighteen inches in diameter; this layer should be beaten smooth with the back of the spade to prevent the beetle lodging under any part of the rough surface. This treatment was found to answer well, for as soon as the beetle in search of food comes in contact with the bare earth it immediately steers its course in another direction, and leaves the plant untouched. The beetle is most destructive in dry warm seasons.—(W. M'C.)

Following up the same principles with different details, it has been found a good plan, where planting has to be done on a large scale, and the beetle is present to any extent, to take out as many of the old roots as possible, burn all the rubbish that is lying about, and graze the ground with cattle for three or four years before replanting.—(W. W. R.)

In the first method of treatment, allowing the growth of grass, and firing it (as is observed), "stamps out" the attack; in the second, the turning of the land into grazing ground for "three or four years," gives time for all eggs or maggots to have passed through their transformations before replanting, and the presence of the cattle and their droppings on the ground are an excellent preservative from weevils being attracted to the spot.*

The following remark is also valuable:—"I strongly re-

* In a young Fir wood of about eight acres in West Gloucestershire that it was wished to keep in trim order in connection with pleasure-grounds, it was the custom yearly to "skirm" (*i. e.*, rough-mow) the ground with briar or common scythes, and fire the rubbish in a large number of small heaps piled amongst the trees, and, where convenient, on the stump of a felled Fir. When proper attention was paid the fire did not run, and this surface treatment, together with the general slight smoke from the smouldering heaps throughout the plantation, was accompanied by (if it did not cause) an absence of Pine Weevils which some years before had appeared in great numbers at the locality.—Ed.

commend surface burning when successive planting is contemplated. This is the safest method of destroying the Fir Weevil in its various stages. If for special reasons the surface cannot be burned, it is well to delay planting for a few years until the weevils are exterminated."—(D. S. S.)

With regard to remedies that are applicable when weevil-attack is present in young plantations of limited extent, hand-picking is a sure but a tedious and expensive cure. The beetles may be gathered into wide-mouthed bottles (J. M'L.), or they might be shaken down on to tarred boards (see "*Otiorhynchus*").

Quick-lime has been found to answer well, when thrown on the ground round the trees, and, from the observations of the beetle-attack commencing at the ground level and gradually stripping the trees upward of their bark, it would appear that any deterrent thrown round the stem would be useful. Ashes or sand sprinkled with diluted paraffin, or gas-lime scattered round the trees, would probably do much good, but, though the beetles occur to a certain extent on the ground, their low and short flights exactly suit them for attack to the young trees, to which they are mainly hurtful; and mere isolation at the roots can only be looked upon as a partial remedy.

The plan of painting over the stem of the young trees with a mixture of paraffin and red-lead has proved fairly successful (up to the date of the note of observation), but was not considered by the experimenter to have then been tried long enough to be certain of its success or its effects on the tree.—(W. W. R.) It has been found that young trees dressed with a mixture known as Messrs. Davidson's composition, used to keep off rabbits, have been free from weevil-attack.*

From these notes it is plain that direct applications to the stems of the young trees are serviceable, and it would be well worth trying whether applications of soft-soap and sulphur, or of gas-water, soft-soap, and sulphur, well laid on with a brush, would not answer (for recipes, see references in Index). Probably smearing the stems with a mixture of cow-dung and lime would do good, or in this case, as the application is not to a food-crop, there would be no objection to using some of the regular insect poisons.

One important point yet remains; it appears that the young plants are most attacked after transplanting, and probably in this case, as in many others, the temporarily altered state of

* I refer here to Davidson's composition, made according to the original recipe, which, as far as I am aware, is only procurable from Messrs. Dickson & Sons, Newton Nurseries, Chester. Since the 1st edition of my Manual was published, I have been given to understand that a slightly altered form of composition has been issued, which very possibly may answer as well as the above, but I am not myself acquainted with it.—Ed.

the sap attracts the insect feeder, and (as in other cases) all possible care to avoid what would prolong this state, or cause a sickly growth, should be given; and when a large extent of ground is covered with Pine plantations, a *very strict* supervision of the method in which the labourers put in the young trees could not fail to do much good.

Note.—In the above paper, as well as in some others (more especially some of those bearing on forest management) I was favoured originally with much information by Mr. Malcolm Dunn, the chief superintendent of the Duke of Buccleugh's gardens at Dalkeith, and by other chief Scottish foresters and gardeners. I acknowledged these contributions in the 1st edition of my Manual by appending initials, and giving names in full in the List of Contributors appended to the vol.; and in this 2nd edition I have preserved the same arrangement, which thus distinguishes the contributions of information to the 1st from those to the 2nd edition, which are for the most part acknowledged together with the note given.—Ed.

POPLAR.

Puss Moth. *Dicranura vinula*, Linn.; *Cerura vinula*, Steph. Cat.

Puss Moth (male), and caterpillar (life-size).

The handsome and very peculiar-looking caterpillars of the Puss Moth feed especially on Poplar and on various kinds of Willow. They are injurious, firstly, by devouring the leafage, and afterwards by the damage they cause to the bark at the part of the stem where they form their cocoon. This attack is reported almost every year, and where it occurs on good-sized trees may do little mischief, but to young trees in nurseries it is very hurtful.

In 1885, especially, I had notes from Mr. J. Low, forester on the Rothes Estate, Fife, of the caterpillars being at work in the middle of summer on Balsam Poplars, from some of which they had entirely stripped the leaves. These trees had been planted in the previous spring, and were from four to five feet high; and in another instance the rapidity with which the caterpillars devoured the leaves was specially mentioned. During the present year a very curious instance was reported to me from Lincolnshire, in which the little trees were so young and small that the quantity of woody material and bark, removed by the caterpillar for its cocoon, had so weakened the slender stem that the young Poplar plant had broken off. In the specimen sent me, the slender stem was completely bared of bark for some little distance from the hard cocoon, and the young plantation was reported to be practically destroyed.

The caterpillar, when full-grown, is of the size and shape figured (p. 265), and may be easily recognised by the position it is fond of assuming, with the fore part raised, as if going to fight, and the head drawn squarely back into the next segment, and likewise by the tail of the caterpillar ending in two rough horn-like prolongations, from each of which, when vexed or alarmed, it has the power of protruding a long streamer, like a morsel of beautiful rose-coloured silken thread.

The colours of the caterpillar are purplish brown, streaked lengthwise with white lines above the white band which is shown in the figure, passing in a sharply-curved course from head to tail, and below this white band the colours are chiefly greenish. When the head is withdrawn into the next segment the part surrounding it is pink, with two black or dark spots somewhat at the sides.

The moths are white and grey, with black markings, so that the figure (p. 265) gives a very fair idea of the tint as well as the shape. From their soft downy appearance they are known as Puss Moths. The female moth is considerably larger than the male figured.

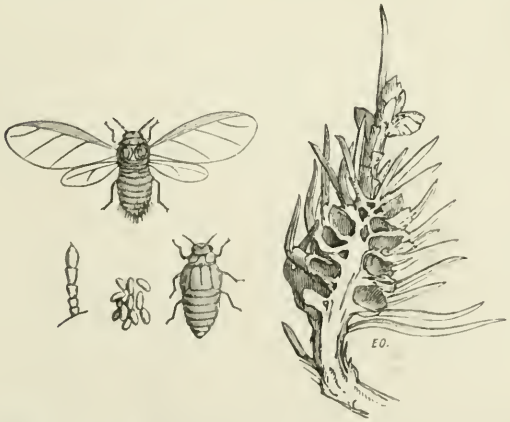
The moths lay their eggs on the leaves of the Willows or Poplars which they infest. When the caterpillars are full-grown they form an exceedingly tough cocoon of a kind of

gluey matter. This may be made either in a hole gnawed in the bark a little above the root of their food-tree, with wood-dust and chips, or, if nothing else occurs, they will glue anything accessible together; in captivity I have found a bit of carpet in the corner of a deal-box suits them perfectly. In this cocoon the caterpillar changes to chrysalis, from which the moth comes out in May or June of the following year.

From the great size of these caterpillars they may be readily got rid of by hand-picking on low trees in nurseries, as soon as the eye of the picker has got used to their appearance. They are not easy to detect at first, from the form and colour of the markings much resembling those of twigs and leaves: when first hatched the caterpillars are stated, except in the case of special varieties, to be almost black. Where attack has been prevalent, examination should be made in autumn as to whether cocoons have been formed on or in the bark of the infested trees, and, if so, the cocoons should be destroyed.

SPRUCE FIR.

Spruce-gall Aphis. *Chermes abietis*, Linn.



Winged female, pupa, eggs, and horn, all magnified. Section of *Chermes* gall in dried state after departure of *Chermes*.

The Spruce-gall Aphis, known also as the Spruce *Adelges*, or Spruce Chermes, causes the small bright green, or green and rosy, galls, shaped like miniature Pine Apples (or some-

what like Scotch Fir cones furnished on each of the divisions with a short leaf), which may be found not unfrequently in the early summer forming at the ends of the shoots of the Spruce Fir.

The mother Chermes, from which the brood of the year originates, is very similar in shape to that of the Larch Chermes, but rather smaller, oval, wingless, and woolly, of various shades of green or purple, with dark legs, and may be found in spring with her sucker inserted in the base of a Spruce bud, thus causing the irritation which starts the diseased growth known as the "Pine Apple Gall" or "Pseudo Cone." Sometimes the shape is perfect, but often only one side of the shoot is swollen, and the other is merely stunted.

The first growth of the gall and the first egg-laying of the Chermes begin in May, or sometimes in the later part of April; and deposit of eggs goes on slowly, the Chermes never stirring from the spot during the time, till, having laid a mass amounting to about two hundred, of various tints of yellowish green or grey covered with wool from her own body, she dies.

The larvæ, which hatch shortly from these eggs, are mere specks in size; when magnified they are seen to have six legs, and a head with horns, and to be in shape much like the pupa figured at p. 267 (at first without signs of the future wings). The colour is greenish, or of a red tint. Meanwhile the growth of the gall—the "Pseudo Cone" as it is called—has been continuing, and the young Chermes larvæ spread themselves, soon after hatching, on its surface, drive their suckers into the soft substance of which it is formed, *and, according to various observers*, become buried in it from the continued enlargement of the base of the unnaturally swollen leaves, of which the gall is chiefly composed, gradually *over*-lapping them. This point is one of much interest. With regard to the larvæ that were hatched *outside* presently becoming *tenants of the inside* of the gall, there is no doubt; but, according to my own observations after long and careful watching of the growing specimens, I believe that at a certain stage of the growth of the gall a minute slit opens along the upper part of the sutures that mark the divisions of the swollen leaves of the gall from each other, and through these openings the larvæ creep into the chambers within.

On this point enquirers may satisfy themselves by watching the Chermes galls at hatching time, with the help of a strong magnifying glass, especially on the afternoon of a sunny day, and noting (should the process coincide with the above observations) the larvæ spreading themselves along the lines which divide the galls into diamond-shaped scales, apparently

piercing into them with their suckers, and then disappearing into the chambers of the gall. When this "Pseudo Cone" has reached its full growth, which may be in four to six weeks, it hardens, the cells split open, and the contained young Chermes come out in numbers. The pupæ are powdery, lead-coloured, and margined and greenish at the sides, from the indications of the tint of the coming wings. When fully developed the skin cracks, and the perfectly-winged insect appears—figured magnified at p. 267 (the natural length, at rest with the wings folded, is about the eighth of an inch). The colour is of a yellowish green, with whitish green wings, transparent green legs, and five-jointed horns, also of transparent green; sometimes the colour of the insect is reddish.

The winged females disperse themselves and begin to lay, and soon may be found dead by their little heaps of about twenty eggs.* "The larvæ which hatch from this second deposit of eggs" . . . "are, in the next spring, the mother Chermes of the attack of the current year."

Wingless male.—In Mr. Buckton's paper on *C. abietis*, published in 1883, in his fourth volume of 'Brit. Aphides,' he mentions having searched in vain for winged males amongst the thousand forms he had reared under bell-glasses, and up to that time the records of observation of the male appear to have been very doubtful. In July of that year, however, amongst a number of galls or "Pseudo Cones" which I had myself been so fortunate as to forward to him, Mr. Buckton "detected, just under a scale, a single apterous insect, which proved to be the sex long missing." This was "exceedingly minute, yellow, blind, apterous, antennæ rudimentary and composed of three joints only. Rostrum very short. Head broad and joined to the body without the intervention of any well-marked thorax. Abdomen large and deeply ringed," &c. —(Vol. of 'Brit. Aphides,' above quoted, p. 31.)

Prevention and Remedies.—When Spruce trees in young woods are much infested they should be felled, and, if cut down in summer whilst the galls are green, all gall-laden shoots should be cut off and burnt. In winter this precaution is not needed, as the old galls are empty, and, if the mother Chermes should lay on the felled shoots, the buds

* The above notes of life-history of the *C. abietis*, and coincidences in the progress of the galls and their Chermes tenants, were taken by myself from long and careful observations of the infestations on Spruce Firs in the plantations of my late father, Geo. Ormerod, at Sedbury Park, Gloucestershire. This being before the publication of Mr. Buckton's standard work on Aphides, I had not the opportunity of comparing my observations; but those who wish to study the subject *in extenso*, with the variations of colouring and many other points of great scientific interest, will find it excellently given in his work on British Aphides, quoted above.

would not develop enough to nurse up the young brood. This clearing of mature, much-infested trees is very important, —cure is hopeless when they are in this condition,— and whilst each year they become more unhealthy under the attack, they form centres to spread the Chermes all around.

Where young trees only a few feet high are attacked, it is desirable to go over them and remove the galls *carefully*, so as not to bruise or tear the other shoots, and it is well to do this as soon as the galls begin to show. The sap that would have gone to the distorted growth is thus preserved for the healthy shoots, and hatching of the Chermes out of the galls is prevented. When growth is more advanced their removal is best performed by a man furnished with an apron with a large pocket; into this each gall should be put as it is cut, and the collection should be most carefully destroyed. An apron is more convenient than a basket, which requires the use of the second hand; but if the galls, save in their earliest stages, are merely thrown to the ground, the Chermes will develop within, and probably be in no way checked by the operation.

How far soil and situation affect the amount of attack does not appear to have been fully noted, but probably they have influence as in other cases of Aphis attack. The worst instances of gall-presence that I have seen were on trees of about thirty years old, which were somewhat overcrowded, and in a damp locality, on a cold, stiff clay; and also, *after removal*, on some fine young trees about three or four feet high, which had been planted in a space in a Fir wood so sheltered by the neighbouring trees and hedges, and also by long rough grass and weeds, that there was no free play of air.

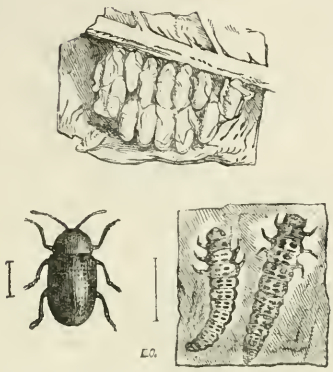
Where there are only a small number of young trees to be attended to, drenchings with any of the Aphis washes in July, or when the Chermes were seen to be hatching, would be useful in clearing many from the trees.

WILLOW.

Willow Beetle. *Phratora vitellinæ*, Linn.

The Willow Beetle, *Phratora vitellinæ*, Linn., is a small oblong-oval, shiny beetle about the sixth of an inch long, of a bronze or green or bluish tint above, more brassy below.

These beetles come out in the spring from their sheltering places, and feed on the leaves of various kinds of Willows,



Phratora vitellinæ: Willow Beetle, caterpillars, and eggs, magnified; lines showing nat. length.

also of Poplars. Later on, the caterpillars or grubs hatched from the eggs of these beetles continue the mischief.

These whitish spindle-shaped eggs are laid in small patches on the surface of the leaves,—whether invariably on the under surface, as in the case of those sketched above, I do not know. The eggs are protected by a loose transparent membranous film. The caterpillars which were forwarded were half an inch long when full-grown, pale yellowish or whitish, with black head; the segment next the head nearly all black above, and a squarish black mark above the two last segments of the grub; the intermediate segments variably marked with black, amongst which a more or less interrupted series of black marks down the back and black spots on the sides, largest on the three segments next the head, were the most noticeable.

Willow leaf partly eaten by Willow Beetle.

These grubs feed on the under side of the skin of the leaf, working right through until the upper surface is only a film, which dries and cracks away. When full-fed the caterpillars *turn to chrysalids in the ground*, and from these a second attack of beetles come up in autumn.

In some years the attacks of Willow Beetles are excessively

injurious, and this was the case notably in 1884, in Willow beds at Lymm, Thelwall, Warrington, and other places on the border of Lancashire and Cheshire. On about fifty acres of Willows grown in the Lymm district it was considered that, unless means had been taken early to suppress the beetle, the whole crop, estimated on an average as worth about £1000, would have been lost. This sum, however, means only the loss of the crop for one year; and if this should happen, the old stocks would not live; consequently the land would require trenching, paring, and burning and replanting the following year, the replanting alone costing something like £15 an acre, and still the risk of being eaten up afterwards.

In the district between Warrington and Lymm, a distance of five or six miles, the Willows were reported as being affected pretty much alike, and on the 29th of May, Mr. H. Cameron, writing from Lymm, Cheshire, informed me that the Willow growers in that district, who were suffering from this insect scourge, had formed themselves into a society for mutual protection and interchange of experience. Of this society Mr. Cameron was the chairman, and the following notes are mainly from observations with which I was favoured by Mr. Cameron, or other residents personally interested in the matter, whilst we were in correspondence how best to stop the attack.

Prevention and Remedies.—It will be seen by the following notes that one of the main points to be worked on for *preventing* attack is that of *the beetles wintering under old or loose Willow bark, or under rubbish on or near Willow grounds*, and, in short, like the nearly-allied "Mustard" Beetle, in any snug shelter, but especially such as is formed of the rubbish of the plant which is its summer food.

Mr. W. Worthington, writing from Wigan on the 28th of May, mentioned:—

"It was noticed that there were two visitations of the pest —the first in May, *when the old beetles* leave their winter-quarters; the second later in the season, just before the Willows begin to ripen. The insects then settle in vast numbers on the tender leaves and shoots of the plants, and in an incredibly short time do an immense amount of damage.

"*When the beetles* leave the Willow beds in autumn they conceal themselves in old fences, hay and corn stacks, crevices of old buildings, &c., where they pass the winter, and emerge to commence their depredations in the following spring, when the Willows have got into leaf."

Relatively to the sheltering of the beetles during winter

under any old bark or similar rubbish at the Willow grounds, which is a most important point in consideration of how to get rid of them, Mr. Cameron remarked :—"Some of our members inform me that during last winter they found a large number of the perfect beetle under the rough bark of the Willow trees, and one grower, who has a wooden hut erected on his Willow field, found, on accidentally removing some of the boarding of this, that the beetles were wintering there in numberless quantities.

"Another informs me that he has found them largely under the bark of old fencing-posts, old boards left lying on the ground under the flood-line, &c.

"This being known, I think some means of trapping during the late autumn or early winter might be devised and prove useful." Later on Mr. Cameron remarked further with regard to *trapping, and also with regard to artificial temporary flooding in order to drown out the beetles* :—"A few growers have put down traps, in the shape of old posts and Birch-wood bark, up trees, &c., in the neighbourhood of the infested Willow beds, and under these traps the beetles have lodged in myriads, and are, of course, being destroyed; but they are mostly found lodged in retreats considerably above the flood-line, and in places where artificial flooding cannot be applied. The pests we find hybernating comfortably under the bark of large Willow trees which grow in considerable numbers along the line up the River Mersey, where the Willow beds are mostly located.

"The Lymm Local Board (of which I happen to be chairman) planted their *new* sewage farm with five acres of Willow last year, and we are arranging to plant six acres additional this spring. All this land is capable of being flooded with sewage, and the experiment will be tried systematically. I am very hopeful of a good result."

With regard to effect of direct applications Mr. Cameron reported on the 29th of May :—

"The remedies hitherto tried (but so far with little success) are dusting the young shoots with hellebore powder, soot, sulphur, lime, and spent gas-lime. *The plan now adopted is to hand-pick, or rather shake off, the insects into small vessels containing a small quantity of paraffin oil.* This plan has been steadily carried on by many of the Willow growers during the last fortnight *with marked success;* but unfortunately a few people take little or no notice, and I fear these neglected lots will pollute the surroundings."

Mr. G. H. Leigh, a Willow grower at Lymm, who tried several experiments for the extermination or prevention of the spread of the Willow Beetle, amongst others tried the

effect of dusting soot on the plants, but the early part of the summer was so dry, with so little dew, that the soot did not remain on the leaves. He syringed them and dusted the soot, but this also was of no use. Hellebore powder was used with the same result, the leaves being too dry to receive it; but even when the effect was tried of putting the beetle into it (in a vessel), in a quantity beyond what could be put on the Willow plant, it took some fifteen minutes to destroy the beetle.

Paris-green "answered much better." Mr. Leigh mentioned that he then tried Paris-green, with about half an ounce to three to four gallons of water. The Willows by this time were grown three feet high; therefore he could not apply a good spray, but the application to the plants on the compass of ground sprayed with Paris-green *was successful.* It scorched the leaves a *little*, and made them curl, which he believed was the cause of the beetle removing itself; but "it did not injure the main shoot." Also, it is noted, "I cannot say it killed the beetle right out, as it immediately dropped to the ground, being always on the alert when anything touched the leaves."

Mr. Leigh added:—"*I am of opinion* that *all rubbish* brought by the winter floods should be destroyed, or buried deep enough so that the beetles could not harbour on the banks.

"I am also of opinion that Paris-green, if used early, would prevent, if not completely destroy, them; and if it was more used with a good spray it would destroy it in the early stage."

At the conclusion of the reports of the summer the Paris-green had been most satisfactory of all the dressings which had been tried, and Mr. Cameron remarked:—"Indeed, I *believe by applying this dressing* early enough the beetle might be kept fairly well under, the difficulty at this season of the year being to get the wash distributed; the Willows grow so thickly on the ground, and so high, that any spray distributed cannot be used. I find the Willows are easily damaged if Paris-green is used stronger than the quantities given by Mr. G. Leigh in his notes. *I think our safety is in early spring work, and trapping of some amount in early winter";* and in the following year, on Jan. 24th, he further observed:—"Where diligent *hand-picking* was attended to, the crop of Willows has proved an average one; and where the *Paris-green dressing* was applied they have also proved a good crop. Where no remedial measures were adopted the growth has been small, the stocks showing damage, and in many cases, I fear, they are ruined."

For application in Willow grounds, the method of operation mentioned in Prof. Riley's 'Seventh Missouri Report' (1875, p. 15), appears to be one of the most convenient, and is as follows:—"It consists of a can capable of holding about eight gallons of liquid, and so formed as to rest easily on the back, to which it is fastened knapsack-fashion by adjustable straps, which reach over the shoulder and fasten across the breast. To the lower part of the can are attached two rubber tubes, which are connected with two nozzles or sprinklers. The inside of the can has three shelves, which help to keep the mixture stirred. There is a convenient lever at the bottom, which presses on the tubes and shuts off the outflow at will, and two hooks on the sides near the top on which to hang the tubes when not in use. On the top is a small air-tube and a capped orifice. Two bucketsful of water are first poured into the can, then three tablespoonsful of good green well mixed with another half-bucketful of water, and strained through a funnel-shaped strainer, which accompanies the machine, and the use of which prevents the larger particles of the green from getting into the can and clogging up the sprinkler. Five to eight acres a day can readily be sprinkled by one man using the can, and from one to one and a half pounds of good green, according to the size of the plants, will suffice to the acre."

In the observations given under the head of Winter Moth (see also Paris-green in Index), which have been made in this country during the present year, there will be found details regarding proportions which it is safe to apply, and information as to apparatus, &c.

The chief points are to try, on a small scale, what amount leafage will bear, and to bear in mind that the green acts by poisoning the beetle or grub, not merely by contact, therefore it should be applied so as to fall *and rest* in the finest possible spray on the leafage, *never drip*. When dripping begins operations should be stopped. Also, it should always be remembered that Paris-green, being arsenite of copper, and consequently a *deadly poison*, requires to be kept and also mixed under careful supervision, especially if there are children about, as the beauty of the colour is very attractive. All requisite cautions and warnings are given under heads referred to, but superintendents should always see that their workers do not carelessly expose themselves to drawing in the powder in breathing, whilst mixing or weighing it out. There is not the slightest occasion for this, for the powder may be purchased damped, or weighed out in pound packages, so that it can be put in water by measure as needed. With common care the green can be used with perfect safety; but if workers will NOT

attend, and WILL inhale the powder in quantity, it *will cause illness;* and if much is inhaled *may be fatal.*

Other washes, such as soft-soap and paraffin or other mineral oil, are very likely to be useful; but one great point of prevention is doing away with winter shelters of the beetles; and amongst these one which I have myself observed, but not seen mentioned, is a thick loose covering or thatch of peelings of the Willow rods on the roof of sheds in the Willow grounds. Where this practice is followed, and these piles are left through the winter, they would be a fertile source of infestation.

PART III.

FRUIT CROPS

AND

INSECTS THAT INJURE THEM.

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APPLE.

American Blight (Woolly Aphis).

Schizoneura lanigera, Hausm.

Woolly Aphis; infested Apple-spray, nat. size; wingless viviparous female and young clothed with cottony fibres above, and small egg-bearing female beneath the spray; pupa with little cottony growth; all magnified.*

The attack of the Apple-bark Plant-louse, or Woolly Aphis, commonly known as American Blight, may be easily detected by the woolly or cottony growth on the insects, giving the

* The above figures are acknowledged, with thanks, as after 1 and 3, Plate CV., and 2 and 5, Plate CVI., in 'Brit. Aphides,' vol. iii., by G. B. Buckton, F.R.S. The size of the wingless viviparous female is given (p. 89 of same volume) as 1.77×1.39 millemetres, that is, something under a twelfth of an inch in length by rather less in breadth.—Ed.

appearance of a white film growing at the bottom of the crevices where a few of them are lurking. Where there are many the spot appears as if a knot of cotton-wool was sticking to the bough, or even hanging down in pieces several inches in length, ready to be wafted by the first gust of wind, with all the insects in it, to a neighbouring bough.

The "Blight" is chiefly to be found in neglected Apple orchards. Its head-quarters are in crevices in the bark, or in hollows where young bark is pressing forward over the surface where a bough has been cut off, or broken by accident so as to leave a shelter of the old dead bark outside; it may, however, be found on almost every part of the tree into which the Aphis can pierce with its sucker; and the harm caused by the attack is not only from the quantity of sap drawn away from the bark or young shoots, but also from the diseased growth which is thus set up. The bark is at first not much affected by the punctures, but the woody layers beneath become soft, pulpy, and swollen. The cells and fibres divide and subdivide, and the bark splits open over the swelling, showing the tissue beneath, which is thus exposed for a fresh attack.

At the end of summer these watery swollen growths dry up and die, and thus form deep cracks. With the return of spring (as in other cases of injury) a new growth forms round the dead part, and this soft tissue is ready for the young Aphides. Thus, from the swollen diseased growth caused partly by the Aphides, partly by the natural attempts of the tree to repair damage, a constantly increasing diseased mass arises, which shelters the insects in its crannies, and finds food for them in its young hypertrophied formations.

The above note of the progress of diseased growth is from the paper by M. Prillieux in 'Comptes Rendus' for April, 1875.

The "American Blight" Aphis is stated to have been imported from America in 1787, but whether this is a fact appears somewhat uncertain. It may be known at a glance from the common Apple Aphis (scientifically *Aphis mali*), which is injurious to the leaves, by the white wool with which it is more or less covered, and from which it takes its name of "Woolly Aphis," and examination of the wings through a magnifying-glass will show that they are differently veined. A strong vein runs down the fore wing near the front edge, and from this three veins turn off towards the hinder edge. The *third* of these veins from the body has only one fork in the American Blight or Woolly Aphis. By this the *Schizoneurinæ*, to which division it belongs, are distinguished from the *Aphidinæ*, which have *two* forks to this vein (as in Hop

Aphis); and from *Chermisinæ*, in which this third vein is absent (as in Larch Aphis and Spruce Aphis).

Winged Woolly Aphis, magnified.

The Woolly Aphides are without honey-tubes (or have them in rudimentary form), and underneath the wool are mostly of a yellowish, reddish, or reddish plum-colour. The winged specimens are described as pitchy between the wings, and green, or with the abdomen of a chocolate-brown. The wingless females may be found packed closely together in the cottony masses, with the pale reddish young moving about amongst them. Winged specimens may be found in July and August.*

Prevention and Remedies.—The great harbouring points of this Aphis, and the nooks from which the broods come forth in spring to infest the trees, are crevices, especially such as are formed of young bark sheltered under old dead masses. It is therefore very important to keep up a clean, healthy, well-trimmed state of the branches, such as will not allow of lurking-places, or, if they do exist, will allow of these points of attack being carefully watched. Boughs must be removed in pruning sometimes, and where the Woolly Aphis exists it is certain to try to effect a lodgment under the ring of young bark that comes rolling forward over the stump; but an eye to this matter, and a few strong soap-suds brushed on the first bit of wool seen, will keep all right; whilst on trees with the boughs maimed by beating the crop off, bad pruning, pieces torn off by the wind, &c., the Aphis gets such a hold in the rough bark as can hardly be got over.

It is also very desirable to keep the trees from touching each other, to keep the ground below them in decent order, at least not totally overgrown with weeds, and to have the soil properly drained. By this means light will be let in, with a free and healthy circulation of air, and the insect-feeding birds will have a chance at getting at the "Blight"; whereas in many of the orchards in the west of England, where the principle is held "trees should touch," the tops look well enough to the passer-by, but there is a different story beneath. Here a pale green light struggles through the thick canopy of leaves. Nettles and rubbish are often knee-deep, and the limbs of the

* For *S. lanigera* and other species, see Buckton's 'Brit. Aphides,' vol. iii.

Apple trees are disfigured with the blight and tumours of many years' growth, and hung with tassels of the wool of the Aphis which shows its presence in destroying hosts. Clean, healthy bark, with proper allowance of air, and light above and drainage below, are the best of all means of prevention.

With regard to remedies:—The colonies of insects remain in one place, and soon die if their food is cut off or their breathing-pores choked; so that anything which will give such a taint to their harbouring-places that they cannot feed, will do good. Soft-soap, tar, or, in fact, anything oily, greasy, or sticky that can be well rubbed on, and which, by adhering for a time, will choke all the Aphides that it touches, will be of use, and amongst these applications tar, being often at hand ready for use, may answer the purpose where nothing else would be used. But it should always be remembered, though this application may not do harm where old thick bark prevents it oozing or melting (in sunshine) into the living tissues of the tree, or, again, might be perfectly safe on the blight-tumours of old trees, it would probably be *very injurious* on young bark that was still living and in an active state.

For washes, or mixtures to be laid on as paint, the following applications have been found of service; but it should be observed that in the case of tobacco-water it is desirable to try what strength tender *leafage* will bear without injury:—

Take a quarter of a pound of tobacco, infuse it in half a gallon of hot water; when cool enough dip the infested shoots in it for a few seconds, or wash the infested parts in the liquor. Repeat this in a few days, if necessary, after which the plant may be washed with clean water. Then dissolve one pound of soft-soap and one gallon of lime in enough water to make it about the consistency of thick whitewash. Apply this with a painter's brush to the stem and all the branches that can be reached, and sift some lime on the ground.

An application is also recommended of half a peck of quicklime, half a pound of flour of sulphur, quarter of a pound of lamp-black, mixed with boiling-water so as to form a thick paint; this to be applied warm. In winter, when the leaves are off, the branches and stems may be painted with this, *all loose bark being first removed.* It is very desirable to remove the soil from the bottom of the stem, down to the main roots, and paint that part also.

For special applications to nooks and crannies anything that is oily, soapy, or greasy will do good, but, as far as killing the insects is concerned, the thicker it is the better, so that it may fairly fill up the crevices in the bark, if possible, and not run off the Aphides till it has killed them by choking up their pores; but at the same time care should be exercised not to

oil or grease *young* bark that may be hurt by the application. A simple lather of yellow soap, laid on with an old shaving-brush, sometimes does all that is needed without fear of hurting the plants, and soft-soap, well rubbed in, would probably be a very effective and lasting remedy.

It is also recommended, on good authority, that about the end of February the trunks and large branches should be scraped, excrescences cut off, and the whole well scrubbed with soap-suds, after which a good coating of lime and water is recommended. Probably the form of "whitewash" that has some "size" in it would be better than the simple lime and water, as the "size" makes it stick better, and thus it is more injurious to the Aphides.

Ammoniacal liquor, diluted with ten to twelve parts of water, will kill Aphides, but (for the reason of it varying in strength, as mentioned elsewhere) experiment should be made as to the quantity of water to be added to make it a safe application to such leafage as it may touch before it is used on a large scale. Apple trees that have the shoots and leaf-stalks infested may be well cleaned for a while by means of water sent from a garden-engine with a flexible hose, or, where the water supply is laid on with a good pressure, the use of a hose with a spreader, throwing the water with considerable force, is better still. A strong and steady stream of water should be directed against every part; and this I have found to wash out the crevices, and knock off many of the Aphides, as well as help to keep up a healthy leafage. If the attack reappears, the treatment should be repeated.

Various kinds of soft-soap washes are, however, probably the best applications, for references to which, mixed with mineral oil, &c., see Index. Amongst these the mixture known in South Australia as "Burford's soft-soap and sulphur compound" might probably be very useful. This consists of soft-soap to which one-fourth of its weight of sulphur is added; this is used as a wash for bark at a strength of 1 lb. to 1 gallon of water.*

A careful watch, and something done as soon *as the wool appears*, is what is wanted; but if the small tufts are left alone, as of no consequence, the insects will soon spread far and wide, and a thoroughly infested tree is an injury to a whole neighbourhood that ought not to be allowed.

With regard to the Woolly Aphis on Apple roots, doubts have been expressed whether it is of the same kind as that infesting the trees, but it appears now to be considered to be so; and, excepting in the matter of stopping passage down to

* See 'Report on Fusicladiums, Codlin Moth, &c.,' by Frazer S. Crawford, Inspector under the Vine, &c., Protection Act. Adelaide, S. Australia, 1886.

the roots from an infested tree, this question does not affect means of prevention. Where Woolly Aphides are found on the roots it is advised by Dr. Asa Fitch to clear away the soil as much as possible from the infested roots, and pour strong soap-suds in sufficient quantity to soak into all the crannies or diseased spots, and either to remove the old soil and replace it with fresh, or to mix ashes with it.

Another observer recommends partially laying bare the roots, and following this up by the application of night-soil. Drainage from stables is said to cure the evil. As the root Aphides in all likelihood pass down from the trunk, it would probably be a great preventive to put a loose rope of hay soaked in tar round the tree at its junction with the ground, placing the band so as to stop passage but not injure tender bark.

Besides the above applications, so many others are mentioned as being used with more or less success, it may be worth while to give the list in some kind of order. It includes tar, kerosine, paraffin, turpentine (diluted), also resin (with an equal quantity of fish-oil, and put on warm); oils of various kinds; soaps of various kinds; ammoniacal liquor from gas-works, and ammoniacal animal fluid, especially drainings from stables; tobacco-water; paints of lime and soap; lime and sulphur; whitewash; oil and soot; and also plaster of grafting-clay to stop up chinks with the blight enclosed.

Of this vast collection of means of remedy, probably the most serviceable are thorough drenchings of some of the soap-washes, applied by means of the garden-engine to the tree directly the attack is noticeable, accompanied by special applications of thick mixtures of soap, or of any kind known to be desirable to kill such of the blight insects as may have remained sheltered in crevices of the bark.

Apple Aphis (Green Fly). *Aphis mali*, Fabr.

These Aphides infest the leaves, and are sometimes very injurious.

The following notes are taken from the excellent account given of the species by Mr. G. B. Buckton, F.R.S., in his 'Monograph of British Aphides,' vol. ii., that being the only life-history I am aware of giving information up to the present period, and to it I refer the reader for full details:—

"The black eggs of *A. mali* may be found deeply buried in the crevices of the bark, and these hatch as soon as the spring sap begins to swell off the buds. The young Aphides puncture

the backs of the thick fleshy leaves, which pricking causes them to curve backwards from their points; and in this manner safe retreats are formed, and shelter from the effects of rain and hot sun."

"The winged insects abound most in July, when they spread their colonies so much that sometimes the vast orchards of Devonshire are wholly robbed of their fruit through shrivelling of the leaves. The bark of the trees sometimes is blackened by the glutinous secretion voided by these Aphides."

This species of Apple Aphis is stated to be very variable both in form and colour. Of the females that produce *living young*, the *wingless ones* (hatched from the egg first in the season, which may be called the mother-Aphides of the successive generations of the year) are globose and soft, larger than those born from these Aphides afterwards, of a dark slaty grey colour, mottled with green, with short dark grey horns and legs. The latter viviparous broods are variable in colour, as green, yellowish, rusty red, &c. The *winged female* bearing *living young* (*viviparous*) has the head, horns, and body between the wings black; abdomen green, with dots on each side; legs yellowish, with black knees and feet. The wings are long, and pale green at the base. The *wingless egg-laying* female is almost globose, of a brownish green colour, with a rusty stain on the head and part of the thorax. The tail and rings next to it are very hairy.

In the case of this plant-louse, there are wingless males; whether there are winged ones also, appears not to be certain. The wingless kind is described as "exceedingly minute, perhaps one-eighth the size of the female" (of which the greatest length given is about the tenth of an inch); legs long; horns longer than the body, and sucker almost equal to it in length.

The early stages of this species of plant-louse much resemble each other in form; the pupa, however, has reddish wing-cases; also, it is usually of a paler yellow in colour than the larva, and has three green stripes on the abdomen.—('Mon. of Brit. Aphides,' vol. ii.)

I have not a figure of this Aphis, but that of the winged viviparous female of the Hop Aphis at p. 119 may be taken as a fair general idea of the appearance of the winged viviparous female of the Apple Aphis described above, and the number and amount of forking of the wing veins is similar.—(Ed.)

Prevention and Remedies. — The soft-soap and other washes, customarily serviceable for Aphis prevention, for which see "Hop Aphis" and references in Index.

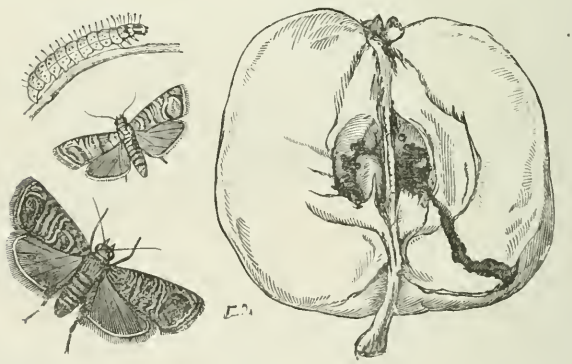
In the case of this Aphis, which blackens the bark and gives the tree a sickly smell from its excretions, thorough and

repeated washings that will clean the leaves and shoots, as well as knock off the Aphides, are particularly useful. Where shoots are still in the first stages of attack, before the leaves are ruined, good drenchings, applied powerfully by means of the garden-engine (as recommended in the case of American Blight), are useful for this purpose, and may be of water or of any of the washes mentioned. Washes containing soap or anything that will adhere to the Aphis, instead of being repelled by its mealy coat, are the most useful.

It is desirable to cut off all infested shoots that are past hope of recovery, or can be spared, and destroy them at once, so as not to allow the Aphides on them to fly or otherwise get about.

The common Blue Titmouse is especially useful in destroying Aphides; and the Cole, Marsh, Long-tailed, and Great Titmouse; also the Lesser Spotted Woodpecker, the Creeper, the Nuthatch, and the Warbler, are stated to be serviceable in clearing insects from Apple trees.—(See observations on insectivorous birds, by Mr. F. Norgate, in 'Report on Inj. Insects,' for 1879, pp. 38, 39.)

Codlin Moth. *Carpocapsa pomonella*, Linn.



Codlin Moth and caterpillar, nat. size, and moth magnified (after figs. in 'Insects Injurious to Fruits,' by Prof. W. Saunders); Apple infested by caterpillars.

The caterpillar of this moth causes what are called "worm-eaten" Apples, which, falling a little before they are ripe, may be known by having a small discoloured spot with a hole in it on the lower side; from this a gnawed passage leads to the middle of the Apple, which is commonly nearly filled with dirt.

The method of attack consists in the moth (when the young

Apples are beginning to form in the early summer) laying one egg in each fruit, usually in the eye of the Apple; from this the caterpillar or maggot hatches, and gnaws its way onwards, taking a direction so as not to hurt the core.

The caterpillar is about half an inch long, and slightly hairy, with three pairs of claw feet, four pairs of sucker feet beneath the body, and another pair at the end of the tail; whitish, with a brown or black head, and dark markings on the next ring, and about eight dots on the others; the food-canal sometimes shows as a dark line along the back. As it grows it continues its gallery towards the stem, or the lower side of the Apple, where it makes an opening through the rind, and thus is able to throw out the pellets of dirt which could not be got rid of by forcing them upwards through its small entrance-burrow. After this opening is made it turns back to the middle of the Apple, and when nearly full grown pierces the core and feeds only on the pips; and as a result of this injury the Apple falls. After this the caterpillar leaves the fruit, and in common course of proceedings crawls up a tree, and, when it has found a convenient crevice in the bark, gnaws a little more of it away so as to form a small chamber, where it spins a white web over itself.

The caterpillar may, however, avail itself of other convenient shelter. Mr. Frazer S. Crawford, in his exhaustive official Report on the Codlin Moth in S. Australia (referred to previously and below), mentions a case where some Raspberries grew under an infested Apple tree, and when the Codlin caterpillars fell they took refuge in the pith of the old cane-stumps. From one of these pieces twenty caterpillars were taken.

In its spun-up chamber (according to German observations) it turns to the chrysalis immediately, from which the moth comes out in a few days to begin a new attack on the fruit; or (as recorded in this country) it lives still as a caterpillar for several weeks, and then changes to the chrysalis, in which state it usually passes the winter; and from this the moth comes out in the following June.

The moth is about three-quarters of an inch in the spread of the fore wings. These have a light grey or ashy brown ground, with delicate streaks, and broader markings of a dark tint, giving a kind of damasked appearance; and at the hinder corner is a large spot of a brownish red or gold-colour, with paler markings on it, and a border of coppery or golden colour around it. The hinder wings are blackish.

Prevention and Remedies.—The main points of prevention are—1stly, all such measures as will prevent the caterpillars

going up the stems of the trees to establish themselves under the rough bark, for their change to chrysalis state; 2ndly, such treatment of the *bark* as would prevent this furnishing the caterpillars with suitable lodgings for the change; and 3rdly, the use of such washes or dressings as would destroy any chance caterpillars which escaped the preventive measures. To the above should also be added disinfecting baskets or packages which may convey infestation in caterpillar or chrysalis state to Apple grounds or stores.

In the first edition of my 'Manual' I offered various suggestions on these points, but the necessary details are so much more fully and clearly given by Mr. Crawford, in his Report previously referred to, that I have exchanged my own observations for those of Mr. Crawford, as follows:—

"*Scraping the trees.*—All Apple, Pear, and Quince trees in an infested orchard should be scraped, and all loose bark removed."

"Spread any old sacks, or other suitable material round the tree as far as any scrapings are likely to fall. Commence on the tree as far as there is any loose bark and scrape it carefully off. Examine and scrape all crevices in the bark, or those formed in the forks of the tree. Continue scraping until the ground is reached. Next gather the scrapings carefully off the sacks, and burn or otherwise destroy them immediately. This scraping should be done annually early in the winter."

"*Washing the trees.*—After scraping the trees a wash should be applied for the purpose of destroying any larvæ or chrysalises remaining in the crannies of the tree." For this purpose applications are advised of which the equivalents in this country are soft-soap and mineral oil wash or "emulsion," mineral oil soap, and "Burford's soap and sulphur compound" (mentioned at p. 283), strength 1 lb. to one gallon of water. These may be best applied by a force-pump, with various kinds of cylone nozzle, or "if these are not attainable a whitewash brush may be used."

"*Banding the trees.*—For this purpose, old sacks, old clothes (if woollen all the better), or brown paper may be used, but the latter is not so good. These should be cut into strips about eight inches in width, and of a sufficient length to go round the trees. Each strip should then be folded in half, and the folded edge again turned down, so as to make the double fold about an inch and a half wide. The band will then be about two and a half inches wide. Insert a piece of cord, or what is better, wire, in the double fold, and tie round the trunk of the tree, about six inches from the ground, taking care that the folds are at the top, and the second fold

placed next the tree." . . . "The wire can easily be untwisted to examine the bands, and twisted again to fasten them on. The bands should be examined weekly as long as there is any fruit left on the trees, as also on any tree which, having no fruit, is yet growing near infested trees with fruit on. Rags or paper should be fastened in the forks of the trees, in order to trap any caterpillars that may leave the fruit without reaching the ground, which, of course, should be examined regularly with the others."

"*Gathering infested fruit.*—This is a most important point. Every apple and pear having a grub-hole mark should be gathered as soon as detected, and all windfalls should be picked up as soon as possible, lest any caterpillars they may contain should escape. This fruit should be at once destroyed, either for kitchen use, or by being given to cattle or pigs, care being taken that no larvæ escape."

"*Fruit cases should be disinfected.* — Disinfect all boxes returned from market, or that may have been in contact with cases containing fruit from an infested district before taking into the orchard."* This may be done by dipping the cases for two minutes in a lye of caustic soda, of a strength of 1 oz. to 3 gallons of water, or by pouring the solution into them; or probably the simpler process of merely thoroughly scalding the cases out would do all that was needed.

As a remedy, spraying when the fruit is formed, but still very small, is recommended. A wash of soft-soap, with a little sulphur may be applied warm, or any other of the regular tree washes at discretion; that is to say, it is best to mix a small quantity and try the effect on one tree first, and wait a few days so as to be quite certain of its effect on foliage and embryo fruit before applying more, unless the grower has experience in the application.

Paris-green, sprayed as a liquid mixture, is recommended as a good remedy by Prof. F. M. Webster, of Purdue University, U.S.A., in his 'Indiana Horticultural Report' on insecticides, p. 1:—"Used in this form, one pound of the poison to one hundred and forty or fifty gallons of water, if applied in the form of a spray, by the aid of any of the machines mentioned at the end of this paper, it will be found effective against the Codlin Moth, and all leaf-eating insects which affect the Apple, provided such application be made after the bloom has fallen, and before the calyx end of the fruit has turned downwards. It may also be used in this way to destroy leaf-eating

* 'Report on the Fusicladiums and Codlin Moth,' &c., by Frazer S. Crawford, Inspector under the Vine, &c., Protection Act. Published by direction of the Hon. Commissioner of Crown Lands. Government Printer, Adelaide, S. Australia, 1886. Price 1s.

insects infesting other trees and shrubs, provided the fruit, if any, be not more than half-grown."

"For the Codlin Moth trees should be sprayed with this mixture for the first time just after the bloom has fallen. The second application should follow in about ten days or two weeks; and the third about ten days after the second. This late application may safely be dispensed with, however, if the season be dry, and few showers fall during the periods between applications, or soon after the second. Only enough of the mixture should be used to wet the foliage without drenching it, as it has been found that, with this amount, enough of the poison will become lodged in the calyx of the apple to destroy the young worm as soon as it hatches and partakes of its first meal. Great caution must be exercised to keep this poison well mixed, as, being heavier than water, it sinks rapidly to the bottom of the vessel, and there is danger of some of the mixture thereby becoming too weak to be effective, and some of it so strong as to kill the foliage. No attempt should be made to spray the trees after the apples have changed their position and the stem end is upward, as the poison will only collect and settle in the cavity about the stem, and render the use of the fruit dangerous to human life."*

For further references regarding proportions of Paris-green which it might be prudent to begin trials with, at ½ a lb. rather than 1 lb. to 150 gallons of water; also for cautions in use of this poison, especially as to non-inhaling the powder in mixing; and for information regarding engines or apparatus for distributing, see paper on "Paris-green" and references in Index.

"Blue Head" Caterpillar of Figure-of-8 Moth.

Diloba cæruleocephala, Linn.

Figure-of-8 Moth, and ("blue-head") caterpillar.

Specimens of this fine caterpillar are now regularly sent yearly amongst samples of the various kinds which are doing

* "Insecticides and their Application," by Prof. F. M. Webster, extracted from Indiana Horticultural Report.'

mischief in the orchards. The grub is very observable from its comparatively large size, being about two inches long when full-grown, and is also remarkable from the head having usually the bluish colour, whence it takes one of its names. The caterpillar is of various tints of green or smoky-green above, and yellow-green below; one yellow stripe (interrupted at distances) runs along the back, and one yellow stripe along each side below the spiracles. The segment or rings of the caterpillar are spotted with black (see figure, p. 290), the one immediately behind the head has eight small spots arranged (on the upper part) in a double transverse row, and the two segments immediately behind have one row of larger spots similarly placed. The following segments (till near the tail) have four spots above. The three pairs of claw-feet are also spotted with black, and the four pairs of sucker-feet beneath the body have two black spots on each.

The caterpillars feed on various kinds of orchard trees, especially Apple and Plum, and also on Whitethorn. When full-fed they spin cocoons formed of bits of bark, or apparently anything that may be convenient,—on twigs or stems, or even on neighbouring walls,—in which the caterpillar turns to a reddish brown chrysalis, out of which the moth emerges about September, also is to be found later on, and in some cases appears in the following spring.

The Figure-of-8 Moth is about an inch and a quarter in the spread of the wings. The fore wings brownish or grey-brown, marked, as shown above, with black lines and white spots, one pair of which, formed of two small white kidney-formed figures in the middle of each wing, form the marking like the number "8," which gives its name to the moth. The hinder wings are brownish, with darker rays and dark patch at the hinder angle, as figured (p. 290). The eggs are green, and laid singly on the stems or branches of the trees.

Prevention and Remedies.—It is stated by Dr. Taschenberg that the caterpillars have such slight hold that in case of a storm occurring they fall off in great numbers. This fact of their loose hold may be very serviceably turned to account by shaking the trees well, and also by heavy washings, and collecting and destroying the caterpillars that drop to the ground.

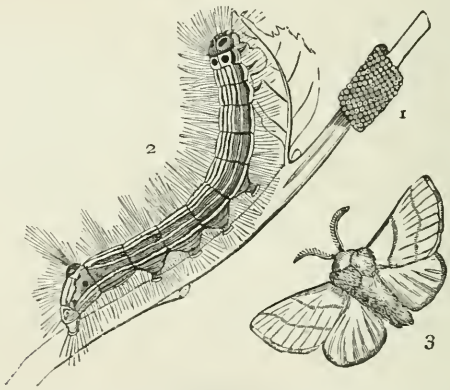
Amongst measures of prevention, scraping and cleaning the bark of the trees and branches would be serviceable here as with various other insect-attacks, as thus some at least of the cocoons which the Blue-headed Caterpillars form on the trees would be got rid of.

Catching the moths by means of lamps.—The moth may be

found from September onwards in the latter part of the year; and on November 18th Mr. C. D. Wise reported to me from Toddington, "We have found and are now catching, by means of the lamps, the Figure-of-8 Moth." The arrangement used in this case was by placing a lighted lamp under an open shed, the underneath part of the roof or boards being tarred and greased.

The various kinds of washes or sprayings used to destroy other orchard moth-caterpillars (for which see Index) would be equally serviceable in the case of this attack.

Lackey Moth. *Bombyx* (*Gasteropacha*) *neustria*, Linn., *Clisiocampa neustria*, Curtis.



1, Cluster of eggs; 2, caterpillar (about one-third longer and wider than natural size); 3, moth.

The caterpillars of the Lackey Moth are injurious to the leafage of Apples and other orchard trees, as well as to Whitethorn, Sloe, Oak, Elm, Birch, &c. They are very easily known by their gay colouring, from which they take their German name of "Livery Caterpillars," and the moth, the name of "Lackey Moth." When full fed (which is about midsummer) the caterpillars are about an inch and a half in length, and hairy; of a bluish grey colour, marked with two black eye-like spots on the head, two black spots with a scarlet space between them on the next ring, and three scarlet or orange stripes along each side, between the two lowest of which on each side there is a blue stripe; these gaily-coloured markings being divided by lines of black, or black spotted with blue. The eggs are laid in the summer or autumn of the preceding year to that in which the attack takes place, and

they may be found in winter and spring arranged in a compact mass, or rather ring-like band on the twigs, exactly as figured (p. 292). From these eggs small black hairy caterpillars hatch about the beginning of May, and immediately spin a web over themselves, which they enlarge from time to time as needed for their accommodation. In these web-nests they live in companies of from fifty to two hundred, and from them the caterpillars go out to feed on the leaves, returning for shelter in wet weather or at night. When alarmed they let themselves down by threads, either to the ground, or else (after hanging in the air till the alarm is past) they go up again by their threads to the tree. When full-grown, which is about the middle of the summer, they scatter themselves separately, and *do not go down into the ground* to turn to chrysalids, but spin cocoons anywhere in reach of their food-trees, as on leaves, or in hedges, beneath the bars of railings, under roofs of sheds, or even on the top of walls, where each caterpillar spins a silken cocoon, mixed with sulphur-coloured or white powder and with hairs from the skin woven into it, and from the brown chrysalis in this cocoon the moth comes out towards the latter part of summer.

The figure (p. 292) shows the shape and size of the Lackey Moth. The colouring is excessively variable, but the fore wings may be described as of some shade of rusty-fox, yellowish, or dark brown tint, with two transverse bars, these being sometimes of a pale tint on a darkish ground, or sometimes, on the contrary, the ground colour is the paler, and the bars dark; and in one specimen before me there is a transverse band between the two bars, of a deeper colour than that of the rest of the wings. The hinder wings are also of some tint of brownish colour.

It is stated that the moths, and especially the females, for the most part remain concealed by day under leaves and in long grass, and come out at night.

The caterpillars seldom do the enormous quantity of mischief with us that they are noted as causing in France, where, according to the old law, it was compulsory on proprietors to have the webs on the shoots cut off with shears and destroyed, in consequence of the ravages of the caterpillars (if left unchecked) ruining the Apple-leafage over an extent of miles of country; nevertheless their attacks are often the cause of much loss in this country, and need attention.

Prevention and Remedies.—Some good may be done by looking for the rings of eggs on the shoots, cutting these off and destroying them; also by destroying any yellow silken cocoons that may be found about the trees, or near them, but

these methods are tedious, and, though they are of use where just a few trees can be carefully tended, are of little service in orchard treatment.

A far better way is to watch for the webs, and, as soon as they are seen, to carry out the old French method and cut the shoots through with a pair of nippers and destroy the web-nests and their contents. But where the plan of destroying the caterpillars in their webs is adopted, care should be taken that this is done when the caterpillars *are within them*. It should be done on an overcast, wet day, or early or late, and it is best for two people to carry out the work. One man should have a pail with some fluid in it,—water and paraffin, or fluid mud with a little paraffin, or anything, in fact, that will prevent the caterpillars that fall in rambling away. If the pail is held by one man, so that the web-nest cut off by the other falls into it, this is an excellent remedy for such part of the attack as may be in reach. In any case, measures should be taken to prevent stray caterpillars returning up the stem of the tree to the leafage.

A less troublesome but less complete method is to shake the boughs, or strike them smartly, so as to make the caterpillars drop, and sweep those that dangle by their threads in the air down with the hand. These may be trampled on, or gas-lime, quick-lime, or anything that will kill them, may be thrown on them; but it should be done *at once*.

Spraying the infested trees is of service with this as well as with other orchard caterpillar attacks; for observations on which see notes under the head of "Winter Moth;" also references to "Paris Green," "Soft-soap Washes," &c., in Index. The Lackey Moths harbour in long grass and leaves on the ground, and, therefore, keeping the trees clear of a *neglected* undergrowth of weeds and rank herbage, such as is too often seen in uncared-for orchards, is a useful measure of prevention.

To what extent birds should be encouraged is a matter for the consideration of the orchard-grower. It is certain that some of the mainly insectivorous kinds give help by clearing out eggs and small grubs from nooks which can be got at in no other way, and that these should to all reasonable extent be preserved; but at the same time bird presence should by no means be encouraged to such an overwhelming extent that they demolish the very crops they were meant to protect. In the case of Lackey Moth, a special word may be said for the Cuckoo as a helper, for this bird is particularly partial to *hairy* caterpillars.

The attacks of the Small Ermine Apple Moth are placed next in order, as they lie to some degree under the same

means of prevention and remedy as those of the Lackey Moth.

Small Ermine Moth.

Hyponomeuta padellus, Linn.; *H. variabilis*, Zell.

Small Ermine Apple Moth, caterpillar, and cocoons, life size, and caterpillar much magnified.

The caterpillars of the Small Ermine Moth are very destructive to the leafage of various kinds of orchard fruit trees, Hawthorns, &c. In 1888 caterpillars of the Small Ermine Moths swarmed to such an extent on the trees in the Fruit Grounds at Toddington, in Gloucestershire, that in the early part of the summer Capt. Corbett (the Superintendent), wrote me they collected the cocoons by bucketsful; and the same kind of caterpillars also did much injury in that year to orchards in Herefordshire, some trees being completely stripped.

The moth lays her eggs in roundish patches on the small twigs, and covers these patches with a kind of strong gum, which is yellow at first, but gradually changes to a dark brown, so as not to be easily distinguishable from the brown twigs. The eggs may be found hatched by the beginning of October, but the caterpillars (which are then little yellow creatures with black heads, and only about half a line long) remain sheltered under the patch of gum during the winter, and do not come out till the leaves begin to unfold in spring. Then it is stated (see 'Trans. Ent. Soc. Lond.,' vol. i., p. 22) that they burrow into the young leaves and feed on the soft matter within, until they are strong enough to eat straightforward at the whole leaf, when they come out from their workings and thus make their appearance suddenly in large numbers where none have been noticeable just before. This part of the attack I have never myself seen, but (without

going into minute details of their earliest life) in the spring or early summer the caterpillars appear on the leafage of the attacked trees, and these continue feeding on the leaves and spinning webs, in which they live together in large companies, until, in severe attacks, the hedge or tree infested is stripped of its foliage, and left hung over with a kind of sheeting of the dirty ragged remains of their deserted webs.

When full fed each caterpillar spins a light cocoon in which it changes to the chrysalis *inside the general web*. The Small Ermine Moth caterpillars are of a dirty ash or ashy white colour, spotted with black; when full grown, the ground-colour is dirty yellow or lead-colour.

The moths, which come out towards the end of June, are about three-quarters of an inch in expanse. The fore wings are usually livid or whitish, dotted with black; the hind wings livid or lead-colour; but they are very variable.

The kind or variety figured (p. 295), of which the moths are distinguishable by the fore wings having the black spots on a pure white ground, and by the cocoons being opaque, was at one time considered more especially to frequent the Apple, and was especially distinguished as the *Hyponomeuta malivorella*, or "Small Apple Ermine Moth"; but for all practical purposes the treatment of the attacks (whether there may be a slight difference in the nature of the "Small Ermines" or not) may be considered together.

Prevention and Remedies.—As the caterpillars of this moth turn to chrysalids in cocoons in their large nests or masses of web, the simplest method of prevention of future attack is to cut off these webs and destroy them with the cocoons within; also, in an earlier stage, if the web-nests, full of caterpillars, can be cut off into a pail of anything that will destroy them (as recommended with regard to Lackey Moth), or if they can be shaken down and destroyed, this is very desirable; but where the ragged webs and small parties of caterpillars are widely distributed over a tree, it is very difficult to manage these arrangements. Where a party of caterpillars are collected together on a bough where the mass can be grasped in the hand and thoroughly squeezed, this will get rid of many very surely and easily.

I have found it answer very well, where there was a good water supply laid on, to wash the infested tree well down with a strong current of water sent through a hose. From the clinging nature of the web the operation took some time to carry out completely, but I have myself thus cleared and cleaned a tree very satisfactorily.

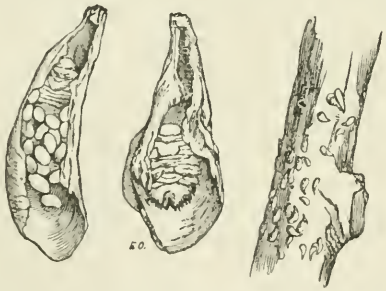
The various washings recommended for remedy of Lackey

Moth attack would be as serviceable for that of the Small Ermines, and in both cases good drenchings of soft-soap, mixed as thickly as it could be applied (with a little paraffin added), well syringed at each web-nest, would have a very good effect.

It has been observed that the whole brood of moths usually hatch from the chrysalis at the same time, when their light colour makes them easily seen, and they are sluggish by day; it has therefore been found useful to spread a sheet under the trees, and by beating or shaking the boughs make the moths fall into the sheet, and destroy them.

Mussel Scale.

Mytilaspis pomorum, Bouché; *Aspidiotus conchiformis*, Curtis.



Infested Apple twig. Female Scales showing female and eggs; and also female shrivelled within the Scale; much magnified.

The Mussel Scales are so named, in this country, from their resemblance to very small Mussel shells.

The infestation is very widely distributed. It is found in Europe, N. America, New Zealand, and Tasmania, but up to 1886 was reported by Mr. Frazer Crawford officially as not having then been noticed in S. Australia. The *Coccus* infests many kinds of trees and shrubs, but with us it is especially injurious to the Apple.

Some kinds are more liable to attack than others, and in my own observations I have found the Wellington especially subject to this infestation. The injury is caused by the little *Cocci* in the early part of their lives inserting their rostrum or proboscis into the tender bark, or shoots, and thus sucking away the juices, and also doing harm to the tissues.

These "Scales" are not the true insect itself, but are shields or *puparia* composed partly of fibrous secretion, partly of the thrown-off insect skins, and differ slightly in the male and female form.

The female Scales are about the tenth to the eighth of an inch long, dark brown, of the shape figured above by myself from English specimens, that is, elongate, slightly curved, and rounded at one end, much smaller and of a rusty colour at the other, and wrinkled across. The male Scale is noted by Mr. Albert Morgan as differing from the female "only in being smaller, and in having one instead of two exuviæ."* Prof. Comstock also notices the male Scale as being "much smaller than that of the female, straight or nearly so, with a single moulted skin, and with the posterior part joined to the remainder of the Scale by a thin portion which serves as a hinge."† The perfect males of the family of the *Coccidæ* (to which this Mussel Scale belongs) differ greatly from the females, as they possess one pair of wings, and have no mouth or rostrum. Whether the perfect male of this species (the *Mytilaspis pomorum*) has ever been seen appears very doubtful.

For the most part the Scales adhere firmly to the bark of the infested tree, and on lifting full-grown female specimens the female itself will be found inside, towards the smaller end of the Scale (sheltered by it, *not* fastened to it), the larger end of the Scale being filled with fifty or more white oval-shaped eggs. The female resembles a flat, fleshy maggot of a pale greyish or yellowish colour, globular, somewhat flattened, and with lines across showing a division into rings, that is, segmented, each segment having, as noted by Dr. Signoret, on each side a lobe with two or three strong spines.‡ After depositing her eggs she dies, and may be found shrivelled inside the Scale. The young Scale insects that hatch from these eggs are very small, flat, and white; furnished with eyes, horns, six legs, and a sucker. These run about with great activity for a few days, but after a while fix themselves and begin to grow, and gradually change in appearance and turn to pupæ. (Under the heading of "White Woolly Scale" will be found figure of larvæ of another species of Scale insect.)

Prevention and Remedies.—Scale may be removed at any time of the year, but the best season for destroying it or applying dressings is in spring, so as to clear it away before the young insects which creep out in May from under the old dead shells have appeared, to begin the new attack.

It may be removed by thoroughly moistening the surface of

* "Observations on *Coccidæ*," by Mr. Albert Morgan, No. 1., p. 46 (1888), reprinted from 'Entomologist's Monthly Mag.' vol. xxv.

† 'Report of Entomologist, U. S. Dept. of Agriculture,' 1880, p. 325.

‡ For further information on *Coccidæ* see "Essais sur les Cochenilles," extraits des 'Annales de la Société Entomologique de France,' 2 vols. Paris.

the infested bark with lathers of any kind of soap (or any dressing that may be preferred), and then scraping the surface with a blunt knife, or rubbing it with pieces of coarse canvas, or well brushing it, so as to clear off the Scale without hurting the bark.

Scraping with a blunt knife is a good plan, as in this way the Scales, Moss, and everything on the surface, are mixed up in a plaster with the soapy lather, and got thoroughly rid of together; if brushing is preferred, good drenchings of soap and water, or of dressings poisonous to the Scale, should be given in addition to the first thorough moistening, so as to wash down or kill all that may have only been disturbed or may be lodged in crevices.

Soft-soap or common coarse household soap are useful for this purpose, and the following recipes for dressings are mentioned as having been found serviceable, and might be varied, in proportion of the ingredients, as thought fit.

One ounce of soft-soap, one pound of tobacco-paper, and four handfuls of sulphur, to one gallon of water; this is to be applied with a painter's brush, taking care to rub thoroughly; use plenty of the liquid, and flood every part of the tree. Three applications in this way are stated to have been always found a complete cure.

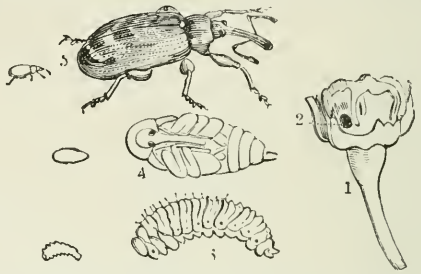
As a means of clearing the Scale out of crevices, it is advised to scrub the trees well at the proper season (that is, during April or early in May) with soft-soap and water, and then brush them over with the following mixture:—Two pounds of soft-soap and one pound of flour of sulphur, well mixed in about fourteen gallons of water.

The following mixture has been found serviceable in destroying Scale insects, Thrips, and other plant-vermin:—One hogshead of lime-water (use half a bushel of lime to this quantity of water); add four pounds of flour of sulphur, six quarts of tobacco-water, and four pounds of soft-soap. This mixture is to be well stirred and incorporated together, and applied by dipping the infested boughs or by syringing. The composition may be allowed to dry and remain on for about a week or ten days, when it may be washed off with clear water.

It is also said to answer to get some tenacious clay, dilute it with water to about the consistency of paint, and to every gallon of this add half a pound of sulphur; mix them well, and paint the trees all over. It is advised to apply two dressings of this, allowing the first to be thoroughly dry before the second is put on. It requires a fortnight to kill the Scale by this application, and when the clay drops off it will bring the Scale with it.

For Apple trees on walls, it is advised to un-nail the trees, prune the young wood back as far as can properly be done (and carefully burn the cuttings), and then wash the wall with cement water, and also clean the branches of the Scale insects with soft-soap wash or any other application preferred.

Apple-blossom Weevil. *Anthonomus pomorum*, Curtis.



1 and 2, Apple bud pierced by weevil; 3, maggot; 4, pupa; 5, weevil; all magnified, with figures showing nat. size.

These beetles attack the flower buds of the Apple before they expand, and in some seasons do much harm, especially in the cider-producing counties; such was noted to be the case as far back as the years 1816, 1831, 1832, and 1838. In the present year I had notes of them from various localities, and as destroying a large proportion of the Apple blossoms before opening at a locality near Hereford. They also attack the flower buds of the Pear.

The method of life of these weevils is for the female to make a small hole in an *unopened* flower bud by means of little jaws placed at the extremity of the long curved proboscis or snout, with which these "long-nosed weevils" are furnished. She then lays one egg in the hole, and with the help of her proboscis she closes the opening; she then goes on to another bud, and may continue egg-laying for two or three weeks; but the date and amount of attack depend much on variation of the season influenced by the weather, for the buds must be formed before the eggs can be laid, and immediately the petals begin to unfold egg-laying ceases. Hatching may take place from the beginning to the end of April; if the weather is warm the eggs hatch in about six or seven days.

Meanwhile the bud grows and the petals are of their usual colour, but presently, instead of opening, they wither, and inside, in place of the stamens and germ, which have been destroyed, will be found a curved, fleshy, whitish, wrinkled

maggot, legless, with a few hairs, and a black horny head (see fig. 3, mag., p. 300).

The maggot turns to an ochry or rusty coloured chrysalis of the shape of the beetle, only with its limbs still folded beneath it (see fig. 4, mag., p. 300) in the injured bud; and here, under the shelter of the brown unexpanded blossom-leaves the weevils develop from the chrysalids in about a month from the time when the eggs were laid, and disperse themselves over the tree, where they are said to injure the leafage, but the most important damage is that which they cause to the flower buds.

These beetles are of the shape figured above, of a reddish brown colour, with three indistinct stripes of a paler colour on the body behind the head; the wing-cases have a large pitchy-coloured patch, with a pale oblique stripe on it, and two ochreous spots towards the tip.

They pass the winter in chinks and crannies, or under loose pieces of the bark, or under clods of earth or stones, and come out when the flower buds are swelling in spring, when the males may be seen flying round the trees, and the females are mentioned by John Curtis as generally crawling along the branches, although they also are furnished with wings.*

Prevention and Remedies. — Much good can be done by clearing away all rubbish round the trees that may serve for shelter during the winter, and also by removing rough, useless bark, and generally keeping the stems and branches of the trees in a well-tended condition.

Where the bark is clean and in good order there will be few hiding-places *on* the trees, and it would be of service to syringe a mixture of any deterrent wash that would not hurt the bark or leaves on to the trees when the beetles are beginning to move about in spring. This would lodge in the crannies where the weevils especially hide, and kill them if they were there, or if they were moving about on the boughs would clear many off. The weevils fall to the ground on being alarmed, and at egg-laying time many might be shaken down from the trees on to cloths spread below, and thus got rid of at an expense which would certainly be remunerative in garden cultivation, and worth a trial for orchard ground in cases where seriously bad attack was known to be going on.

Where trees stand in bare ground, stirring the surface in winter so as to turn the weevils out to the birds would do good; and there appears to be reason to think that sticky-

* For history of *A. pomorum* by John Curtis (Ruricola), from which part of the above is extracted, see 'Gardener's Chron.' 1841, p. 556.

banding the tree in spring would very likely be of use in preventing some at least of the female weevils creeping up the trunk for egg-laying. It is observed by John Curtis that "from various statements it seems that the females will not readily fly, and as they creep up the tree their incursions may be stopped, and the crop saved," by the use of proper bandages. In the past spring I had notes from one observer, suffering much under attack of this weevil, that he thought the females *did* fly, and therefore banding was considered by him to be no good. It would be therefore well to band a few trees in good time, so as to secure some of the very earliest part of the attack (in case it does come on foot up the trunks); and if on examination the little weevils are found in the bandages, then at once to band the rest.

It will be noticed that the weevil lays no more eggs after the flower-buds begin to expand, so that in fine sunshiny weather the time of egg-laying is much shortened; also she lays on calm days, sheltering herself from wind or frost; and, reasoning practically on these habits, it would appear that trees so placed and managed as to have plenty of sunlight and air around them and amongst the boughs are less likely to suffer, than where close-growing trees (even so early as the flowering time) keep sunlight and air from circulating properly, and where, though the buds on the upper parts of the trees expand in their due season, there are many others coming on slowly, on the imperfectly-ripened wood beneath, still available for the weevil.

Many of the applications noted under the head of "American Blight" and "Codlin Moth," would be of service in preventing attack of this weevil.

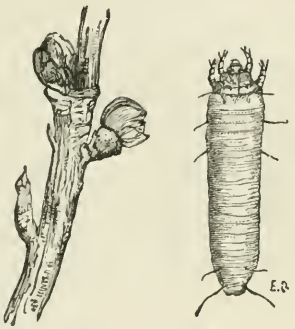
CURRANT.

Currant Gall Mite. *Phytoptus ribis*, Westwood.

The *Phytopti*, or Gall Mites, are, as mentioned under the head of "Birch *Phytoptus*," excessively small creatures of the shape figured, which live together in large numbers, and give rise to diseased plant-growth, often in the shape of galls on the leaves, but sometimes, as in the case of the Black Currant and Nut, causing an abortive growth of the leaf buds.

They are not true insects, but, like the "Spinning Mites" (the so-called "Red Spiders" so injurious to the Hop leafage),

belong to the order of *Acarina*, or Mites. The subfamily of the *Phytoptidæ* are distinguishable by their peculiar long, somewhat cylindrical, shape, and by having only two pairs of legs placed close together beneath the fore part of the body, which ends in a kind of conical projection containing the mouth-parts. The details of those of the Black Currant Gall Mite have not been described (as far as I am aware), but those of the Pear-leaf Gall Mite consist of excessively fine sword-shaped jaws fitting on each other like scissor-blades,* these being contained, with other minute apparatus, in the somewhat conical proboscis.



Phytoptus (species ?): infested buds; Gall Mite enormously magnified.†

The skin is much wrinkled across, and the mite, besides its two pairs of legs, is furnished with various large bristles, regarding the nature of which there has been much discussion. The creature being excessively minute (so that the smallest dot visible to the naked eye would be too large to convey an idea of the size), there is great difficulty in saying with any certainty whether various attacks to various plants are caused by one or various species of the mites.

Where I have traced the life-history the mites hatched (in the same shape and with the same number of legs with which they continued through their lives) from an egg (see p. 212), which was of a perfect egg-shape at first, but which became, towards hatching, very irregular in form, being pushed out by the pressure of the mite inside, which I saw in the act of coming out. As the mites grow they cast their skins, and these empty cast-skins may be found among the living multitudes.

The injury to Black Currants consists in the mites, which

* For further details of the Pear Gall Mite, see 'Der Milbensucht der Birnbaume,' von Paul Sorauer.

† For figures of seven kinds of *Phytoptus* attack, by Editor, including that on Black Currant, see 'Economic Entomology: Aptera,' by A. Murray, article "Gall Mites," pp. 355—361.

shelter themselves in the buds, feeding on the outer surfaces of the embryo leaves, and setting up a diseased growth, which first causes a swollen condition of the bud, distinguishing it very plainly from those in a healthy state, and at last renders the whole, leaf-bud and flower-stem together, abortive, and is sometimes known as the "Rose-bud" Currant Gall.

Amongst specimens sent me I have found as many as seven diseased leaf knobs, which could hardly be called buds (from a quarter to three eighths of an inch across), on one Black Currant shoot only about three inches long.

From notes sent me in 1887, by Mr. J. Le Tall, from Hackenthorpe, West Sheffield, this mite disease had been noticed on Black Currants for fifteen years before that date, but during the last few years it has become much more prevalent. It is now regularly reported yearly as a serious cause of loss to Black Currant growers in various localities both in England and Scotland, and when once established is found to be most difficult, if not impossible, to be got rid of by any measures except thorough eradication of the infested plants; but from notes sent me, and from my own observations, I should say that the infestation establishes itself gradually, and that by keeping good watch severe settlement of attack might be forestalled.

Prevention and Remedies.—On May 7th, in 1885, Mr. Arthur Bull forwarded me specimens from the neighbourhood of Cottenham, Cambs, with the information that there was about half an acre so affected, and "the attack had been coming on for two or three years." When attack is first observed, it would be very desirable to cut off attacked shoots and to burn them; or if there are only a few galled buds noticeable, to break these carefully off and destroy them; or if only a very few bushes were attacked these should be cut off at ground-level and burnt, the stumps dug up and burnt also, and caustic gas-lime or quicklime thrown about where each bush stood. This would answer at first, but afterwards, as the mites stray about and shelter under rough bark or in crannies near the ground, and are almost certain to come out again from them to cause new injury, it is excessively difficult to deal with them. The most hopeful remedies seem to be mixtures such as those used for Red Spider or for Scale Insect, especially mixtures of sulphur and soft-soap applied as syringings; these run down the shoots and lodge in the crannies and between the buds and the stem, and thus clog up the nooks which shelter most of the mites not in the buds.

The following recipe, given by Mr. Arthur Bull, would probably be very serviceable, as boiling the sulphur with some lime would make it dissolve:—

"I use a dressing of two parts sulphur and three parts lime boiled together in water (2 lbs. sulphur and 3 lbs. lime, 3 galls. water), which is further diluted at the rate of two or three pints to a large pail of water, applied with a syringe to the infested bushes; the effect is to keep the 'spider' down, and that little or no damage is done. It seems difficult to clear the garden altogether."

Another recipe, to save the trouble of boiling the lime, is as follows:—Take of sulphuret of lime 4 ozs. and of soft-soap 2 ozs., to each gallon of hot water. The soap and sulphuret to be well mixed before the addition of the water, which is to be gradually poured on, stirring being continued during the process. This mixture may be used as a syringing, but, if poured in thick condition on the stems about a foot or two from the ground and let run down into the centre of the bushes, it would choke myriads of the minute creatures. Good waterings, and all treatment calculated to promote hearty growth, would be likely to be of service.

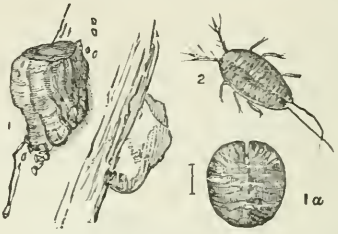
Where attack is established, probably the best treatment is to clear the bushes and burn them (as well as any rubbish lying on the surface of the ground) *where they stood*, or to put a couple of shovelsful of fresh gas-lime where each bush stood, so as to kill the mites that may remain. They cannot fly, but are easily dispersed on leaves blown by the wind, or by crawling.

Change of crop to something that the Gall Mites will not attack is obviously desirable where there has been infestation, and *for all practical purposes*, as far as I am aware, all other plants may be considered free from this attack. There is, however, just a doubt whether the Red Currant can be infested. In 1888 I was favoured by a specimen of a shoot of Red Currant (infested with bud galls like those of our Black Currant) sent me by Dr. Friedrich Thomas, of Ohrdruf, Gotha, a most eminent authority on Phyto-pathology, with the information that he had observed them for many years in his own garden, but up to that time no notice of the attack had been practically taken in Germany. He likewise mentioned that the identity of the Gall Mites which cause the respective attacks on Black and on Red Currants had not yet been made out. Still it will be desirable to watch whether infestation appears on the Red and White Currants, and in case of importation of plants from Germany, care should be given to this point.

Skimming off just the top surface of the ground with the old leaves on it when they have fallen in autumn, and burning it, would do something towards preventing spread of infestation, taking care, of course, to work well in round the neck of

the branches at ground level, so as to get out all harbour for the mites; but the matter is very difficult to meet, and as in the experiments on the *Phytoptus* of the Orange in Florida, the best results given were those of treatment with whale-oil soap, it may be hoped that *thorough* application of Mr. Arthur Ball's recipe above given, of soft-soap with sulphur, might be of service.

White Woolly Currant Scale. *Pulvinaria ribesiæ*, Signoret.



Pulvinaria ribesiæ: 1, female and woolly egg-sac, mag. (nat. size given at p. 308); 1*a*, female Scale, mag., with line giving nat. length; 2, larva, mag.

The accompanying sketch (see p. 308) is taken from a photograph of a Currant-bough infested by the White Woolly Currant Scale, the *Pulvinaria ribesiæ*, Signoret, a kind of attack which is known in France, but which, although we now find that it has been present at various places in England and Scotland during the last few years, has not been scientifically identified and recorded as present in Britain until June, 1889.

On June 18th, specimens of the attack were sent me from the garden of Mr. George Parkin (by whom they were first observed at Wakefield), by Mr. S. L. Mosley, of Beaumont Park, Huddersfield, with a note that it evidently "seemed at home where it was established, and that the Red Currant bushes were terribly affected by it"; and he drew my attention to the very great number of eggs in the cottony matter surrounding the Scale.

The specimens were submitted by Mr. S. L. Mosley to Mr. J. W. Douglas, of 8, Beaufort Gardens, Lewisham, S.E., for authoritative identification, who reported on them as follows:—"The Coccids you sent are *Pulvinaria ribesiæ*, Signoret ('Essai sur les Cochenilles,' p. 219), a species found on Red Currant bushes in France, and which I have long expected to hear inhabited Britain, but until now I have not seen it." As this kind has not yet been brought forward

here, I append in a note* a translation of Dr. Signoret's scientific description. My own more general description, from specimens examined on June 2nd, is as follows:—

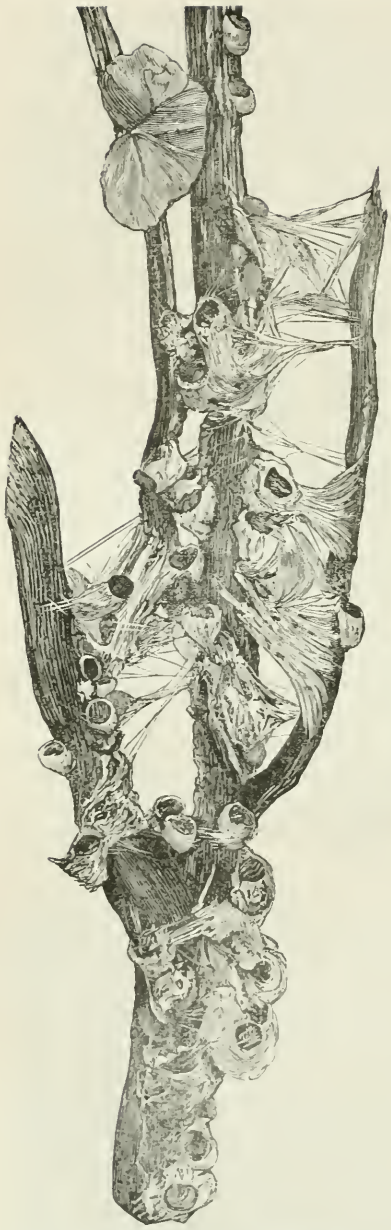
The Scale itself (see fig. 1*a*, p. 306) dark grey-brown, rather longer than broad (the specimens measured from one-eighth to three-sixteenths of an inch in length, and over one-eighth of an inch in width), of a squarish oval, with the hinder extremity notched or heart-shaped, and in their then dried state the fore part turned up so much as to be reflexed; the keel along the back was still partly observable, with slight ridges running down to the edge of the Scale.

The white cottony or woolly matter (figured at 1, p. 306) which forms the nest of the eggs, and of the young Scales in their earliest condition, formed, where it was undisturbed, a compact tuft, on the front part of which the Scale itself was raised, sometimes almost vertically. Whilst fresh, the Scale and its white wool formed together a somewhat oval mass, which presently became drawn out in all directions, so that in the distance the infested branches looked as if they were scattered over with whitewash (see accompanying figure, p. 308, from a photo kindly taken for me by Mr. T. P. Newman, of 54, Hatton Garden).

The almost overwhelming nature of the infestation, and the serious amount of injury caused by it is better conveyed by this figure, taken from one of the various samples of attack sent me, than from mere description.

The egg-like bodies in the wool, when examined at this date (July 2), proved to have hatched, and these orange-coloured larvæ were dispersing themselves in vast numbers in the box in which the spray of infested Currant sent me by Mr. Mosley was secured.

* "In its most advanced stage, this species, which is nearly allied to *P. vitis* and *P. oxyacanthæ* is 4 mm. long by 3 broad, not including in this the white cottony matter, which may vary in extent according to the state of growth of the embryos which it contains. The Scale is of a reddish brown, with a line more or less raised on the back, which gives it almost the appearance of being keeled; on each side of the body it is wrinkled, and faintly pitted: in a dry state the folds are hardly observable—it might be said to be smooth. It is nearly allied to *vitis*, but smaller, thicker, rounder, more heart-shaped, and of a deeper brown; *ribesiæ* is distinguished from it, especially in the embryo state, which is longer, with the members thicker, the tarsi and tibiæ much shorter, and half less in size in *P. ribesiæ* than in *P. vitis*, and the large hair which is observed on the tibia in almost all the species is very much longer in this one; the antennæ, almost of similar form, have fewer long hairs; thus in the embryo of *Pulvinaria vitis* six are observable, whilst in *ribesiæ* there are only five, of which that of the third article and that of the disc of the last article are much the longest, the great hair at the extremity of this article being a good third shorter than these. With regard to the cottony matter which is observable, it is very abundant in this species, and entirely of the same nature as that of *P. vitis*." 'Essai sur les Cochinelles,' 15, *Pulvinaria ribesiæ* nobis, par M. le Docteur Signoret, p. 219 (vol i. of Collected Essays).



Currant branch infested by White Woolly Scale.

These very active young Scale insects (fig. 2, p. 306) were whitish or orange in colour, of a flattened oval shape, broadest near the head, deeply cleft at the caudal extremity, with a long hair or filament on each side of the cleft, that is, one long filament placed on each lobe caused by the cleft, and in the centre of the cleft a long cylindrical process. The body somewhat raised along the centre, with slightly indicated corrugations along it, and side ridges from it, and the surface slightly sprinkled with white or woolly morsels. Eyes dark or black. One of the special characteristics by which this species is known is the number and length of the hairs on the antennæ, but in the size figured I have only been able to indicate that hairs are present.

The attack occurred on Black, Red, and White Currants, and on the ornamental kind commonly known as the Flowering Currant; possibly also on the Mountain Ash. Although the first duly identified observation of the appearance of the *P. ribesiæ* in this country did not occur until the past season (1889), yet an attack which is now recognised as the same was observed so far back as 1880; and notes from various places accompanying specimens sent

mention the senders having known of the presence of the infestation for two, five, or six years previously, though they did not know its name. These Currant attacks, with the exception of the infestation at Wakefield and Huddersfield (and that at Ballater, which is not very far inland), were observed on or near the sea-coast on the East of Scotland, namely, in the neighbourhood of Banff, Aberdeen, Stonehaven, Arbroath, Edinburgh, and Berwick-on-Tweed.

Prevention and Remedies.—The plants, or parts of plants, most affected (where specially reported) were bushes nailed to walls, or not fully exposed to light and air, or the under side of branches; consequently, all measures of good cultivation adapted to keep the branches or the bushes from being crowded up together or overshadowed would be useful, as also keeping a watch on Currant branches nailed to walls, where any infestation which especially affects the sheltered or under side of branches has every chance of establishing itself.

With regard to remedies, on July 21st, Mr. William M'Kenzie wrote me from the gardens under his charge at Glenmuick, Ballater, Aberdeenshire, that in 1880 the garden was visited by this Currant pest, and, as he had never, after a long experience, seen it before, he first tried the common application of soft-soap as a remedy. This proved useless, as also did dilute paraffin-oil, which, as Mr. W. M'Kenzie justly remarks, is an application not generally to be recommended, as it may do much harm if not judiciously used. These applications having failed, in the following year (1881) Mr. W. M'Kenzie "applied a dilution of hot lime in the autumn, going over the bushes with a brush (the same process as whitewashing), occasioning the bushes to shed or throw off the bark, and thus effectually curing them of the pest, without in the least injuring the bushes." The proportion used was "two pounds of lime to one gallon of water, being of the same consistency as is used for whitewashing walls." This application Mr. M'Kenzie found to be an effectual and permanent cure, and later on he forwarded me excellent specimens of both White and Red Currants, gathered off the previously-mentioned bushes, to show that the remedy had proved thoroughly effective against the infestation, and done no harm to the plants.

Where only a little of the infestation appears, it would be desirable at once to use the above or some other serviceable application, for if soft-soap alone did not answer, probably some of the common soft-soap and sulphur applications would not fail to kill the minute larvæ straying in crowds over the bushes. But where remedies could not be brought to

bear, it would be best to cut off and burn the infested branches, or to destroy and burn the infested bushes if it could be done without serious loss, and thus stamp out this newly-observed pest in good time.*

GOOSEBERRY.

Magpie Moth; Currant Moth.
Abraxas grossulariata, Stephens.

Magpie Moth, and larva.

The caterpillars of the Magpie Moth sometimes do a great deal of mischief, both in gardens, and in fruit-farms, by stripping the Currant and Gooseberry leafage.

The Magpie Moth is widely distributed, and the caterpillars are injurious from Kirkwall, in the Orkneys, and Poltallock, in Argyllshire, to the south of England, and, besides the leafage of Black, Red, and White Currants, and also of Gooseberries, which they habitually feed on, they are sometimes found on that of Apricots and Plums, and especially frequent Sloe or Blackthorn hedges. In 1885 the attack was very prevalent. Mr. S. L. Mosley, Beaumont Park Museum, Huddersfield, reported to me:—"The Magpie Moth has been more numerous than for many years before. Here it has been abundant in one or two places, and has entirely stripped the bushes. I have also seen it commonly in Cambridgeshire, Lincolnshire, Notts, and parts of Yorkshire, and I have notes of its extreme abundance near Bradford, Ilkley, Pickering, &c."

* Full details of observation are given in my 13th Report on Injurious Insects, pp. 43—49.

The egg—one or more—is laid on the leaves during summer, and the caterpillars appear towards August or September, and feed for a while. Before winter they secure themselves either by spinning themselves up in leaves, which hang by spun threads from the boughs, or by dropping with the leaves and sheltering themselves at the surface of the ground. Next spring the caterpillars come out again and feed on the new leafage, till towards May or the beginning of June they spin a light cocoon, in which they turn to chrysalids, from which the moth comes out towards the middle of the summer.

The caterpillar is one of the kind known as "loopers," from the peculiar looped shape it assumes in walking (see fig., p. 310); the head is black; body cream-coloured, with a reddish orange stripe along the sides, and large irregular black spots along the back; the whole of the second ring, and the under side of the third and fourth, and of the four nearest the tail, are also reddish orange. The very gay colouring distinguishes it plainly from the greenish or green and black-spotted caterpillar of the Gooseberry Sawfly, which is still more common and destructive, and as the Magpie caterpillar has only *two* pairs of sucker-feet (in addition to the three pairs of claw feet near the head), being therefore obliged to raise itself into an upright loop when walking is another distinction.

When full fed it spins a light transparent cocoon attached to twigs, or palings, or in crevices of walls; and in this it changes to a chrysalis, yellow at first, but afterwards shining black, with orange-coloured rings, from which the moth comes out about midsummer or rather later.

Common form of Magpie Moth.

The moth is very variable in its colouring, but when regular in its marking is easily known. Commonly it has a black head, yellow body between the wings, with a large black spot in the middle; the abdomen also yellow, with five rows of black spots. The wings are white, spotted with black, and the fore wings have a yellow blotch at the base and a yellow band across them. There are, however, almost endless varieties of markings, from black of different shades, to white;

some have the upper half of the wing white and the lower black, or the reverse; some have the ground colour of the wing (instead of merely a band) yellow; and in some cases the hinder wings are striped with black.

Prevention and Remedies.—The best method of preventing attack from these caterpillars in the spring is to destroy them whilst they are torpid during the winter. There is a difference of opinion as to whether the caterpillars winter beneath the fallen leaves on the ground or each in its folded leaf-cradle hung from the bough. However this may be, they may easily be got rid of by gathering the fallen leaves together from under the bushes, scraping up just a film of the surface-soil with them (so as to ensure none of the grubs being left behind), and at the same time casting a glance over the bush and picking off any hanging leaves that may be seen.

The habit of the caterpillar of wintering on or under the food-bush is *the* one to be acted upon to get rid of it thoroughly, but *very* early autumn pruning and dressing of the ground beneath the bushes should be avoided. I have had notes from two localities where this was customary of caterpillar-attack being bad, and the reason seems obvious. If the caterpillars have either not become thoroughly torpid, or the weather is still open enough for them to re-establish themselves in shelters, many will escape by creeping away or sheltering in the disturbed surface, which otherwise would have been destroyed by winter operations. If the bushes are properly pruned and all hanging leaves cleared, and likewise the surface-soil with the fallen leaves upon it scraped off, and either carried quite away or so treated that the caterpillars in it will be destroyed, the plan will answer as well to check repetition of the attack next spring as it does with that of Gooseberry Sawfly caterpillar. The pests being absolutely cleared out from under the bushes, there is nothing to come up in any stage of life.

Thorough cultivation is a good preventive for this attack; where the bushes are properly pruned, and consequently carefully examined during the winter, there can be very little harbourage left on the boughs for the caterpillar; and a good forking beneath the bushes, with an addition of manure, especially of the rich sorts applied in Gooseberry-growing districts, cannot fail to much diminish the number of caterpillars sheltered on the ground. A ring of ashes sprinkled with tar, or with any cheap sticky mixture (see "Lubricants" in Index), put towards March or April round each Gooseberry stem (at a few inches from it), would keep any caterpillars from being able to crawl up it.

When caterpillars are first found to be attacking the bushes (as they do not throw themselves down readily on disturbance), many may be got rid of by a man with scissors in one hand and a jug or pail (with some mixture in it that the grubs cannot escape out of) in the other, snipping off the infested leaves into the vessel.

All the measures of hand-picking, shaking down, and destroying the caterpillars under the bushes, dusting with various applications, dressing under the bushes in winter or early spring with lime or gas-lime, &c., which are found serviceable in checking the attack of Gooseberry Sawfly caterpillar, and of which an abstract is given in the following paper, would be equally serviceable in lessening damage from Magpie caterpillars, which are easily kept in check by moderate care.

Gooseberry and Currant Sawfly. *Nematus ribesii*, Curtis.

Male Sawfly, caterpillars and cocoon; all magnified. After figures in Reports of Ent. Soc. of Ontario. Dimensions given below.

The attack of Sawfly caterpillars on Gooseberry leafage is one which appears certain to show itself more or less every year; and often, and especially in bush-fruit growing districts, causes great loss to the growers. The chief characteristics of the attack are only too easily observable; but for further information as to habits, all necessary details will be found in the paper on this Gooseberry Sawfly, published by John Curtis in the vol. of the 'Gardeners' Chronicle' for 1841, from which most of the following notes of the life-history of this insect are taken.

The female Sawfly appears about April, and lays her eggs on or beside the largest veins beneath the Gooseberry leaves. The grubs hatch in about a week, and begin feeding on the leaf on which they are placed, which they soon pierce full of small holes. "Thus they go on feeding and changing their successive skins as they increase in size, until they are three-fourths of an inch long, when they are seen scattered round the edges of a partly demolished leaf, holding by their fore legs with their tails turned up, or lying on one side.

"At this time they are dull pale" (or bluish) "green. The first ring behind the head, and also the last ring but one, are deep yellow; the head, feet, tail, and some dots on each segment, are black. When full-grown they cast their skins for the last time, becoming of a uniform pale green, excepting the spaces behind the head and near the tail, which retain their yellow tint, and there are also two little black dots on the head; the rest of the black spots are moulted off."

The caterpillars, as mentioned at p. 311, may be known from those of the Gooseberry Moth by having a larger number of sucker-feet; they have a pair of sharp horny feet on each of the three segments next to the head; the fourth segment is footless, but the following *six* segments are each furnished with "*sucker-feet*," or "pro-legs," like short fleshy legs, and there is a similar pair at the end of the tail, known as the "caudal pro-leg," making twenty feet in all.

After the operation of casting the skin they rest awhile, and then crawl down the stem of the bush or drop from a bough, and at once begin to bury themselves. When deep enough, which may be two or more inches, according to the nature of the soil, they form a yellow-brown cocoon of a gummy secretion, in which they turn to chrysalids. From this the Sawfly comes out in about three weeks during summer; in the case of the late broods the grub remains unchanged in the cocoon during winter, and does not turn to the chrysalis till spring, in time for the Gooseberry Sawfly to make its appearance as the Gooseberry and Currant bushes are coming into leaf.

The male Sawfly (figured p. 313) is about half an inch in the expanse of the wings, the female rather more; the head and body between the wings are ochre-colour or yellow, variously marked with black; abdomen yellow or orange; legs yellow, with brown or black tips to the feet and hinder shanks: horns brown or black. The four wings are transparent and iridescent.*

* See "Gooseberry and Currant Sawfly," by Ruricola. 'Gardeners' Chronicle,' vol. i., p. 548.

Prevention and Remedies.—*Autumn or winter removal of surface-soil from under the bushes.*

For prevention of all attack, excepting what may be borne on the wing by stray Sawflies blown from elsewhere, I believe the above plan to be the most certain.

The caterpillars go down in autumn a little below the surface, the depth varying from about two inches to somewhat more, according to nature of ground. There they lie in small brown cocoons, like little pellets of earth, during the winter; and when the leafage comes out in the spring, so do the Sawflies from their cocoons under the bushes, and lay their eggs to start attack on the leaves. If the earth is removed, with the cocoons in it, and got rid of in any way, the amount of attack is enormously lessened.

Amongst communications sent me yearly from 1878 to 1884, inclusive, by superintendent horticulturists and others, regarding prevention of Sawfly-attack, the following notes refer more particularly to this simple method of clearing out coming mischief:—

"For twenty years Gooseberry Sawfly caterpillars have not occurred in the gardens under treatment, in any quantity. The surface-soil under the bushes is annually removed in winter, a deep hole is dug in one of the quarters, and in this the removed soil, *with whatever may be in it*, is buried. The soil under the Gooseberry bushes is replaced by that out of the hole, with the addition of some manure."—(Alex. Anderson, The Gardens, Oxenford Castle, Dalkeith, N.B.)

"When there is reason to fear an attack" [*i.e.*, when there has been bad attack the previous year (Ed.)] "the soil should be removed to the depth of two inches round the bushes in the early spring, and a good sprinkling of lime dusted round each bush; by this means the caterpillars are cleared away and destroyed."—(George McKinlay, The Gardens, Kilconquhar House, Fifeshire.)

"Caterpillars not nearly so injurious as last season. During the winter I removed all the surface-soil from under the bushes."—(John Matheson, Addington, Winslow, Bucks.)

"Gooseberry bushes in my garden, from beneath which the earth had been scraped a few inches deep in the previous autumn and replaced by manure, &c., were free from attack."—(Ed.)

I also received a note from a gardener in the district near Isleworth, where Gooseberries are largely grown, that one method of treatment is to scrape all the surface from beneath them in the autumn and to form it into a line between the rows of Gooseberry bushes, and there *dig it in*.

In this way a great amount of attack is prevented, but it is

necessary to be careful as to having the scraped-off surface-soil *dug in very thoroughly*. On one occasion I saw the first part of the operation carried out on a large scale,—the earth was scraped from under the bushes and formed into lines between them,—but there work stopped; consequently the cocoons lay just as safely as if nothing had been done, and when spring came the Gooseberry leaves were again riddled by the caterpillars. The plan advised (p. 315) by Mr. Alex. Anderson, of digging a deep hole and burying the infested earth safely away, is much more secure.

This complete removal of the soil with the cocoons is quite worth while wherever Gooseberry caterpillar is prevalent; but, in case of the surface-soil not being removed, a layer of unslacked lime, well mixed with the soil as deep as the cocoons are, would be highly beneficial. Gas-lime also would be of service, well sprinkled on the surface, if fresh, or lightly pricked into the surface-soil beneath the bushes after it had been aired for a few weeks, taking care not to let it lie against the stem.*

The following notes refer especially to use of *Lime or Gas Lime* as above mentioned. Mr. George Brown, writing from Watten Mains, Caithness, N. B., mentioned:—"Year after year these attacks occur, and nothing in the shape of prevention is ever attempted; dressing with quick-lime, *and clearing away the earth beneath the bushes*, seems to be the best and surest measure."

Mr. Arthur Ward, writing from The Gardens, Stoke Edith Park, Hereford, noted:—"Currants and Gooseberries out in the open garden have kept quite free from caterpillars (on the *open ground*); this, I think, was owing to the trees being dressed with lime early in spring. We have had very fine crops, and the flavour is excellent. Currant trees on the *wall*, which were not dressed with lime, were attacked. The attack commenced on the bottom of the tree on the leaves nearest the ground."

At Callendar Park Gardens, Falkirk, Mr. T. Boyd mentioned:—"I dress over all my Gooseberry ground with gas-lime in early spring before forking over the soil, and have not seen one of these caterpillars for three years." And Mr. Thomas H. Hart, of Park Farm, Kingsworth, Kent, also reported:—"I am now satisfied that I have benefited by the application of gas-lime between my bushes. Grubs there certainly have been, but, whilst they have almost stripped other bushes of their leaves, those on the dressed ground are little the worse for the attack."

When the caterpillars are observable on the bushes, hand-

* For references to method of use of Gas Lime, see Index.

picking, or shaking down and destroying, syringing, or dusting with various dry dressings, sulphur more especially, have all been found to answer.

Handpicking has been especially recommended, or the less tedious, though less complete, way of shaking the caterpillars down; or syringing, and then shaking and destroying the grubs by trampling, or throwing hot lime on them. The plan of having freshly tarred boards placed below the bushes to retain them as they fall, or beating down on to cloths and collecting the vermin and destroying them, also answers well.

For syringing the following mixture has been recommended:—Three gallons of warm soap-suds, half a pound of soda, half a pound of salt, and a handful of soot; the bushes to be syringed on a still day when the sun is off them. Half an hour after the application the plants should have clean water dashed over them. It is stated that this mixture does not injure either the young fruit or leaves, and soapsuds by themselves syringed on the bushes have been found useful. In short, anything that annoys the caterpillar, and makes the leafage distasteful to it *without injuring the leaves*, will be of service; but at the same time the fluid applications are hardly practicable on the large scale of fruit farming.

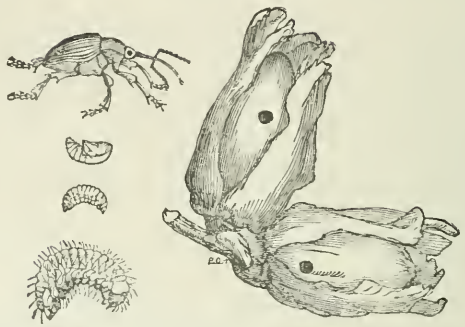
Dry dressings are more easily applied on a broad scale, and amongst these flour of sulphur has been especially recommended, dusted on the leaves when the dew is on, or if in dry weather after watering.

Mr. W. J. Goodwin, of Winfield House, Crouch, Sevenoaks, reported that he considered "the best remedy for Gooseberry caterpillars is to give a liberal sprinkling of fresh, good soot early in the morning when the trees are damp, two or three large handfuls to a good-sized tree, so as to make it *quite black with soot*. It is of no use unless it is done when the trees are *damp, so that it sticks on well*. If it comes off by rain coming shortly after, it must be done again. It acts, of course, as a first-rate manure afterwards, causing the trees to make good wood for another year."

Roached lime, hot lime, and soot, and various other dry dressings, all would be of use applied so as to adhere, as above mentioned, to the leaves. But *the* thing to prevent infestation coming seriously, year by year, as it is apt to do when once established, is to get rid of the cocoons, as mentioned at p. 315, so thoroughly during the winter, that no vermin remains to give trouble. From my own observation and personal experience, I believe this plan of prevention to be thoroughly satisfactory.

NUT.

Nut Weevil. *Curculio nucum*, Linn.; *Balaninus nucum*, of 'Curtis' Guide.'*



Nut Weevil, magnified; nat. length 3—5 lines; pupa, nat. size; maggot, nat. size and magnified; bored Filbert.

The fat whitish maggot found in Filberts and Hazel nuts is the larva of the Nut Weevil.

These beetles, or weevils, may be seen about the Nut bushes early in the summer, the females usually creeping along the twigs, the males often on the wing. Whilst the Nuts are still young the female pierces a hole through the soft shell by means of the jaws with which she is furnished at the end of her long snout. In this hole she lays one egg, which hatches in about ten days. The maggot feeds inside the Nut, consuming a large part of the kernel. When full-grown it is of the shape and size figured above, of an ochreous white, with horny chestnut-coloured head, furnished with strong black jaws; without legs, but supplied with muscles inside the large transverse folds or wrinkles, which enable it to draw itself through the earth.

When full-fed the maggot eats a hole through the Nut shell, sometimes whilst the Nut is on the bush, sometimes after it has fallen to the ground in the premature ripening which appears

* See paper on the Nut Weevil, "*Curculio nucum*," by "Ruricola" (John Curtis), 'Gardener's Chronicle,' vol. for 1842, p. 108. In this paper Curtis gives the synonym of *Balaninus nucum*, of Germar, as being then the more generally used name. This is now one of the synonyms of *B. elephas*, of Stephens' 'Manual'; and as the true Nut Weevil is very variable in its colouring, and there are many synonyms of different species, I have given the original name at heading, in order to be sure I give the insect referred to by Curtis.—Ed.

to follow on the maggot-attack. It then buries itself, forms a cell in the earth, and "frequently rests there during the winter, and only changes in the following spring or later" to a pupa or chrysalis of whitish colour, like the future weevil in shape, but lying quiescent with its limbs folded against it.

The weevils are described by John Curtis as of a tawny brown colour, densely clothed with short depressed hairs, the proboscis polished and bright chestnut-colour, the wing-cases clouded or variegated with ochreous and reddish brown transverse marks, and with ten lines of punctures on each, wings ample. Other writers describe this weevil as being clothed with greyish or yellowish down, and with a whitish or yellowish scutellum, but it is very variable in colour. The very great length of the proboscis is one distinction.

The weevils may be found as early as May, at which time development from the chrysalis has been recorded, but it is stated that some of these beetles do not develop till July or August, and it is still open to observation whether some of these do not hybernate and appear with those newly out of the chrysalis in the following May.

Prevention and Remedies.—In this case the best means of prevention lie in the regular measures of good cultivation. It is stated the Filbert likes a Hazel loam of some depth, "which should be dressed every year, as the Filbert requires a considerable quantity of manure."—('Enc. of Gardening,' J. L.) It is also mentioned by Mr. C. Whitehead that "in Kent the Nut grounds are well-manured every other year with rags, shoddy, fish, or fur waste, and are always cultivated by hand, and kept scrupulously clean."

This course of treatment, that is, treatment which involves stirring the surface-soil as well as additions, is suited to expose some of the chrysalids and bury others deeper, and is generally useful for insect prevention, but especially as regards the Nut Weevil, which (in instances observed) has been found to be so tender at the time of its transformations as to require eight or nine days to gain its colour and hardness, and also strength enough to force its way up through the ground. Looking at these points, it seems likely that if the chrysalids were buried a little beyond the natural depth many of the weevils from them would not be able to come up at all.

Where weevils are very abundant on the trees, it has been advised to beat them down, but this should not be done on a sunny day, or they will speedily take flight and escape; and (saving for treatment of a bush or two) probably the only way to carry out the plan of beating serviceably would be either to put tarred boards, or for one man to throw a sprinkling

of quick-lime or gas-lime under the Filbert trees whilst his companion beats down the weevils.

It is desirable to remove all Nuts that fall before their proper time, that the maggot inside may thus be carried away before it has bored its way out; and also, looking at the powers of flight of the weevils, it would be well not to have many Hazel Nut bushes in copses adjacent to Filbert ground.

PEAR.

Wood Leopard Moth. *Zeuzera æsculi*, Linn.

Leopard Moth. Female, head of male, and caterpillar.

The caterpillars of this moth feed in the live wood of many kinds of trees. They are to be found in Pear, Apple, Plum, and Walnut; also in Ash, Beech, Birch, Elm, Holly, Lime, Oak, and others, besides Horse Chestnut (*Æsculus hippocastanum*), from which the moth takes its specific name, though not appropriately, as it rarely attacks this tree.

The eggs are laid during July, or later in the summer, in crevices of the bark, and on the branches as well as the trunk of the trees; these eggs are oval and salmon-coloured, and as many as three hundred have been seen laid by one moth. The caterpillars, which soon hatch, feed at first in the bark, but not long afterwards they make their way into the live wood, where they bore galleries rather wider than themselves, and as much as a foot in length. When full grown they are about

an inch and a half long, whitish, or yellow, or ochry, with a black horny plate on the segment behind the head, and the tail segment also is partially black and horny. The other segments have each four raised black spots on each side, and the head is black, or has two black spots.

They feed (or feed at intervals) through the winter until May or June (statements are made that they live for two years), and, when full-fed, they spin a web, or form a case of wood-dust, in which they change to an ochreous brown, long, cylindrical chrysalis. This web is usually woven just inside the bark, near the entrance of the boring, so that when the time for development is come the chrysalis forces itself through the opening, and, by means of the fine prickles with which it is furnished along the back, it is held firmly in the web whilst the moth frees itself, and leaves the empty case projecting from the tree.

The moth is large and handsome, the female from about $2\frac{1}{4}$ to $2\frac{3}{4}$ inches in spread of the wings, the male much smaller. The wings are somewhat transparent, and are white with blackish or blue-black spots, the spots being darkest on the fore wings, which also have yellow veins. The body between the wings is white spotted with black, and the abdomen grey, or grey banded with black.

It is stated that the female moths appear somewhat later than the male, and may be found until the end of August.*

Specimens of this attack, chiefly in caterpillar stage, are not unfrequently sent me, but it is very rarely mentioned as being prevalent. In 1879 it was more common than usual near Maldon, in Essex; and, during severe weather in the winter of that year, a few specimens of caterpillars were brought to me in small boughs, or rather in thick twigs, at Isleworth (near London), quite uninjured by the cold. In 1880 it was noticed as very numerous at Craighall, Blairgowrie, Perthshire; many empty pupa-cases being observable in young Poplars at the water's edge, and it was also observed in that year as very injurious in fruit and timber trees at West Ham, in Essex (so that measures were taken to destroy the caterpillar), but excepting these observations no notes have been sent of it as a serious infestation.

Prevention and Remedies.—The caterpillars may be destroyed (like those of the Goat Moth) by drawing them out of their burrows with hooked wires, or by running a strong wire into the hole, and thus crushing the caterpillar within to

* For descriptions see paper on *Zeuzera æsculi*, by J. Curtis, in 'Gardener's Chronicle.' Vol. for 1846, p. 236; and Stephen's 'Illus. Brit. Ent.' Haustellata, vol. i., p. 8.

death. If the wire, when withdrawn, is found to have wet whitish matter on it, such as would result from having crushed the larva, or again, if gnawed wood should have been passed out of the burrow up to the time of the operation and no more appear afterwards, it may be supposed the creature is killed; otherwise the operation should be repeated.

Syringing is also of service in getting rid of these caterpillars. For this purpose a gutta-percha tube with a sharp-pointed nozzle may be fitted to the syringe, and thus, by placing the point of the nozzle well into the hole, it may be filled with strong tobacco-water, soft-soap, or any mixture that may be preferred, such as will make the hole too unpleasant or poisonous for the grub to remain in, even if it is not killed by the application.

The fumes of sulphur blown into the holes are also very effective in destroying the caterpillars (M. D.); and tobacco-smoke has been suggested for the same purpose.

This moth is preyed on by bats.

Common Vapourer Moth. *Orgyia antiqua*, Linn.

Caterpillar (after Taschenberg). Male Moth. Female Moth, with abortive wings.

The pretty and easily distinguishable caterpillar of the Common Vapourer Moth is not so well known as it should be, on account of its destructive habits. In the words of Edward Newman ('Brit. Moths,' p. 40), "it feeds on every tree or shrub in the garden." Hawthorn and Sloe are especially frequented, but it also feeds on the leafage of Pear and other kinds of fruit trees; of Roses and other garden plants; and sometimes on Fir.

The caterpillars are very noticeable from their peculiar tufts and bunches of hair. They are dark grey, spotted with small red tubercles, and the four large tufts of hair on the back are whitish or yellowish; those at the head and tail, and the two long tufts at the side, are dark. When full-fed the caterpillar spins amongst the remains of the leaves on which it has been feeding, or in some exposed place, as on trunks of trees, palings, or the like, and there it changes to a dusky

yellow chrysalis, from which the moth comes out in summer at the end of about fourteen days.

The male moths are of various shades of brown or chestnut, with the fore wings clouded with darker colour, and with a white, somewhat moon-shaped, mark near the hinder angle. The females are grey, and have only abortive wings. When they come out from the chrysalis they creep on to the outside of the yellowish grey somewhat oval cocoon, and there pairing takes place. The female very soon begins depositing her eggs on the surface of the cocoon and in the immediate neighbourhood, and then dies.

It was observed by Edward Newman ('Brit. Moths,' p. 40), "that these eggs do not hatch all together, like those of moths in general, but come out a few at a time over a period of ten weeks, so that the caterpillar, chrysalis, and moths, are all found together throughout the summer and autumn." The eggs of the late moths which remain unhatched through the winter were seen, when under special observation by Dr. Taschenberg, to hatch out their caterpillars about the 23rd of April. This infestation is found both in town and country, and I have had specimens from various localities, some from Porchester Terrace, London, where the infestation had done much mischief.

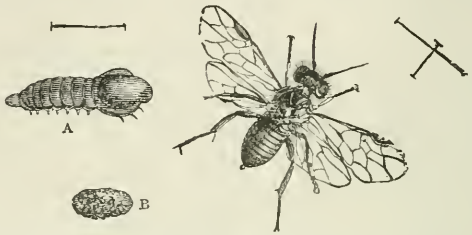
Prevention and Remedies. — As the female moth cannot fly away, the attack may be expected (if once set up) to continue and to increase yearly. Careful measures to get rid of it at once when observed are therefore well worth while, and the fact of the moth laying her eggs on or near the webbed-up leaves or the cocoon may be turned to good account.

Where bad attack is noticeable, all the webs that can be reached should be cut off and burnt, and walls (where infested trees were fastened against them), and boughs, and any places where webs with eggs on them are likely to be, should be searched, and the webs or cocoons destroyed.

Syringings with soft-soap and other applications, such as are used in the case of other moth-caterpillar attacks, would be of use when the caterpillars were attacking the leafage,— also for preventing the moth developing from the chrysalis, and coming out of the cocoon, — and also for clearing away the infestation from the branches, or trunks, or neighbouring shelters.

Slug-worm of Pear and Cherry Sawfly.

Selandria atra, Westwood; *Tenthredo cerasi*, Linn. (of Curtis).



Tenthredo cerasi; Slugworm and Sawfly magnified, with lines showing nat. length; cocoon.

The Slug-worms feed on the upper surface of the leaves of the Pear and Cherry, clearing away the whole of the soft substance of the leaf, so that the veins and the skin of the lower side are all that remain; they are also to be found on Plum, Hawthorn, and Sallow, from the middle of August until October.

For all practical purposes the Slug-worms may be known (when at their work of destruction) by their blackish or bottle-green colour, together with their peculiar shape, and the covering of slime or moisture exuding from their skin, which gives them something the appearance of a Slug, but still more that of a lump of wet black dirt fallen on the leaf and run together at one end. They appear also to be known by the sickening smell observable where many trees are infested.

In respect to the scientific definition of the species there has been much difficulty, from some kinds of *Selandria* being nearly alike in their perfect state (and probably in appearance and habits whilst still "Slug-worms"); and consequently, whilst there are many synonyms for one species, there is also doubt whether two species are not given under one name. Therefore, for clearness, I give the following note entirely from the observation of John Curtis, attaching to it the name he applied of *Tenthredo cerasi*, and quote the description of colouring of the legs of the Sawfly in full, as this is one of the points requisite in determining the species.

The Sawflies appear in July, and deposit their eggs on or in the upper side of the leaf; these eggs are oval, and hatch in a few days. The larvæ are of the lumpy shape figured above, much the largest at the back of the head; they are furnished with ten pairs of feet, that is, one pair on each of

the three segments next to the head, and a pair of sucker-feet on each of the other segments, excepting on the fourth from the head and the tail-segment, which are footless.* When feeding, they keep the end of the tail a little turned up.

In four or five weeks these Slug-worms arrive at their full growth, which is about half an inch in length, cast their dark bottle-green skins, and appear as yellow or buff caterpillars, free from all shine, and transversely wrinkled, instead of being perfectly smooth. In the instance noted this happened at the beginning of October, and the caterpillars shortly after left the leaves and went down into the ground, where they spun an oval brown silken cocoon covered outside with earth, from which the Sawflies came up in July in the following year.

The female fly (figured, magnified, at p. 324) is of a shining black, tinged with violet; the wings often stained with black, with dark nerves, and a dark brown mark (the stigma) along the fore edge.

"The four anterior legs are brownish ochre, and the others are more or less of that colour, but generally much darker; and the thighs, or at least the base, are pitch-colour."†

This species of Sawfly was considered by Curtis to be the *Tenthredo cerasi* of Linnæus, but from subsequent record by Prof. Westwood, of the nature of the perfect fly reared by him from larvæ of the kind described above, it appears that *Tenthredo cerasi*, Linn., is not the correct name, but (from his own observations) Prof. Westwood became convinced that the Sawfly under consideration is the *Selandria atra* of Stephens.‡

These points of nomenclature, however, do not appear in any way to affect the practical matter of the life-history of the infestation, and how to get rid of it.

From the notice of "The Pear-tree Slug" published by the Entomological Society of Ontario, it appears that the Sawflies are double-brooded in Canada. The flies appear in May; the eggs are deposited singly in little slits cut for them in the skin of the leaf by the ovipositor of the female, and these produce a brood, coming out in the perfect state in July; from which a second brood arises, which is full-grown in September or October. These remain in the ground

* From other observations of the *Selandria* (the genus to which this Sawfly is now considered to belong), a small pair of caudal prolegs, making with the others in all 22 pairs, were overlooked by John Curtis.

† See "Slug-worm," by John Curtis, 'Gardeners' Chron.,' 1842, p. 692.

‡ See "Sawflies of the Pear," by Prof. J. O. Westwood, 'Gardeners' Chron.,' 1848, p. 524; and for further notes under the synonym of *Eriocampa limacina* see 'Brit. Phytophagous Hymenoptera,' by P. Cameron, p. 224. Observations are also given, at pp. 226 and 228 of the same work, as to involvements of nomenclature.

during the winter, and for the most part appear (as above mentioned) fully developed in the following May; but some remain in the ground unchanged till the following year.—('An. Rep. Ent. Soc. of Ontario,' published by the Legislative Assembly, 1874.)

The attack is of frequent occurrence in this country, and in 1887 I received an unusual amount of applications regarding the injury caused by the "black leech-like caterpillars" or "jelly-like grubs" to the leafage of Pear trees as far north as Bawtry, in Yorkshire, and Cherry trees at Hexham, in Northumberland. It was also reported in one case (at Bridgend, Glamorganshire) as attacking Quince leaves.

Prevention and Remedies.—The Slug-worm attack can be checked by dusting or syringing. The caterpillars, if annoyed by throwing a caustic powder on them, such as quicklime or gas-lime, can throw it off at first by exuding a coating of slime, and thus, as it were, moulting off the obnoxious matter; but they cannot keep on continuing this process; therefore a second application of the powder (of course soon after the first) takes effect and kills them. If a good time is allowed to elapse between the dressings, they will have regained the power to produce the slime exudation, and the dressing will do little good.

Heavy syringings of the tree with strong soapsuds, applied by a powerful garden-engine, are very effective in getting rid of this pest. Tobacco-water will destroy them; and lime-water has also been found useful, in the proportion of a peck of lime to thirty gallons of water; it is noted that if two pounds of soft-soap are added, it will improve the mixture.

The Sawflies have been found to fall to the ground on the tree being shaken, and to remain for a short time motionless; consequently it would be a good plan to place boards covered with wet tar, or cloths, beneath the trees, and shake the flies down on them early in the morning or late in the evening (or at whatever time it was found they were collected on the leafage), taking care that they were destroyed before they could escape.

The recurrence of the attack, which, when once established is a very common circumstance, may be prevented by skimming off the surface of the ground and removing the cocoons. These may lie below the surface at from one to about four inches deep, according to the state of soil. If the earth is stirred over by a competent observer, little balls, probably much resembling the colour of the earth they are in, will be found, and may at once be identified by just tearing the spun case open, when the caterpillar or, later on, the

chrysalis, will be found within. When once the observer has found how deep these cocoons lie, it is easy to have the surface-soil removed to just below that depth, and by removing this and *destroying it, with the cocoons within it,* the infestation may be fairly carried out of the place; but care must be taken that the cocoons *are* destroyed, or otherwise the Sawflies that hatch out of them will fly back to the trees and begin the attack over again. Where this plan is carefully carried out, there will be little damage to be expected from recurrence of attack.

PLUM.

Plum Aphis; Plum Green Fly. *Aphis pruni*, Reaumur.

"*Aphis pruni* is exceedingly destructive. Multiplication takes place by millions, and the insects close up the pores of the leaves by their tenacious excretions and the mealy exudations from their bodies. By the constant irritation of their rostra [suckers] the leaves roll up, and under this cover from the weather both the winged and apterous forms live overspread by the before-mentioned mealy powder, which probably to them is a protection."—(G. B. B.)

The wingless female bearing living young is of various tints, from green to slight olive-brown, with three faint green stripes on the abdomen, short olive-brown horns, and brown eyes; the winged viviparous female is apple-green, with head, horns, body between the wings, and feet, black.

The winged male is small, dingy ochreous, with the head, part of the body immediately behind it, some markings on the back, and the feet, umber-brown; the fore wings are large and broad; sometimes the insect is black. It has been found in November in company with the wingless egg-laying female, which is small, pale greenish yellow, and transparent; and usually shows the mature eggs within, which are ready for laying.

The Hop Aphis (*Phorodon humuli*) may also be found in great numbers on Plum and Damson trees, and trees or bushes of the Plum kind, as late as May or June (that is until it takes flight to the Hops); and it may be found again on the Plum trees in autumn. The two kinds are so much alike that they might be mistaken at a glance, but they may be readily distinguished, with the help of a magnifying glass,

by the Plum Aphis—the *Aphis pruni*—never having the large frontal tubercles (figured, much magnified, at p. 119) which are characteristic, together with the lowest joint of the horns being gibbous or toothed, of the Hop Aphis,—the *Phorodon humuli*. The difference in size of these very minute insects is indistinguishable by the naked eye.

Prevention and Remedies.—Washes with a foundation of soft-soap are the most desirable, because they have the great advantage of sticking in some degree to the Aphides. When these insects (as before noted) are covered with a kind of mealy powder, many of the washes used simply run off them at once; and unless the application *sticks to them*, so as to kill them, or is given so violently as to knock them from their position, the labour does little good.

Washes or regular "swillings"-down, applied as in the Hop-grounds by means of a large garden-engine fitted with a gutta-percha tube and jet, or rose, or spray-syringe, so as to send the mixture under the leaves, as well as over and round the whole of the tree, and thus drench it down completely, do good in many ways. They knock many of the Aphides off, they cleanse the leaves of the accumulating dirt which is choking them, and also make the surface distasteful to the plant-lice for a while; something might be done in the autumn or winter or early spring to lessen impending attack of the next season by destroying the eggs on the Plum-stems or branches.

Some kinds of Aphides hybernate, and of some we cannot be sure whether they do so or not; but in the case of the *Aphis pruni* I am not aware of there being any record of the Aphis living through the winter, and we know (as mentioned, p. 327) that the eggs are ready for laying in November.

Washings and syringings with soft-soap mixtures, with anything mixed with them that would coat the egg and poison the embryo, or poison the young Aphis when it hatched in spring, would be very serviceable. This course is recommended in German orchard treatment; and for these purposes, that is, to destroy Aphis eggs, or Aphides harbouring on the trunk or branches, the soft-soap and mineral-oil emulsions, and washes mentioned in Index and also under the heading of "Winter Moth," would be serviceable.

Where there is plentiful water supply at hand, and also means of throwing it with force, I have known much benefit come from sending even this, with no additions, strongly at the stems and branches; fairly "swilling" the tree down. Whether the quantity of water thus running down to the roots would be injurious in late autumn or winter would be a

point for consideration, but at growing time it is beneficial, and, by means of a good strong current sent at the more solid parts of the tree, a most serviceable amount of clearing of spring insect vermin may be effected. For application to kill Green Fly on the Plum trees, the following mixture was reported on the 17th of May, by Mr. C. D. Wise (Deputy Superintendent), as found serviceable in the Toddington Fruit-grounds, namely:—Quassia and soft-soap in the proportion of two ounces of each, to each gallon of water, and Paris-green added in the proportion of one ounce to ten gallons of the decoction.

On the 20th of June Mr. J. Masters, Secretary of the Evesham Fruit Conference Committee (to which I have myself the pleasure of acting as Entomologist), favoured me with the following useful notes regarding Aphis destruction:—"A strong solution of soft-soap and quassia and paraffin oil, in the strength recommended in your 'Manual,'* I have found the best remedy. But it is very difficult to get at them by spraying owing to their being coiled up in the leaf.

"The committee consider that the trees should be sprayed early, before the pest has developed.

"I had a row of trees last year, and the foliage was severely injured by the Aphis. This year, before the trees had bloomed, we gave them a good syringing with soft-soap and a little paraffin oil (according to your report), and this year we have no attack of the Aphis in these trees; but other trees near, that did not suffer from the Aphides last year, and where we did not dress the trees as above, we have found are severely affected this season."

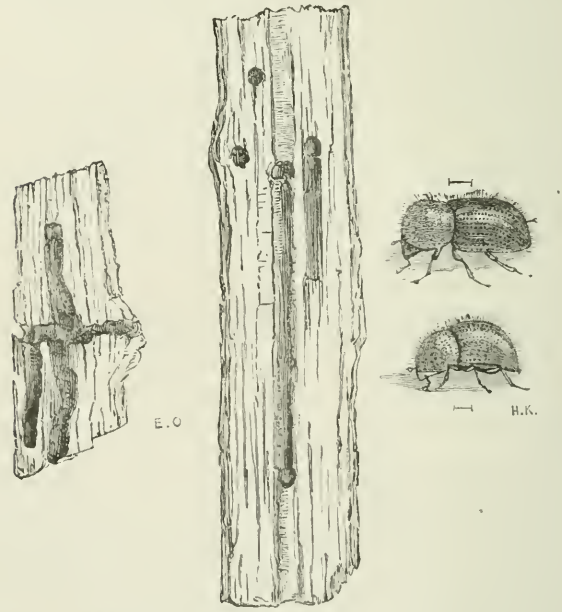
A decoction of quassia chips and soap, or soft-soap, has been found serviceable both for syringing infested trees and also on a smaller scale for dipping shoots in. One recipe for the mixture is—one ounce of quassia boiled for ten minutes in a quart of water, and a piece of soft-soap the size of a small hen's egg then added. Quassia is a well-known "fly-poison," but, having found that sometimes flies which appeared to have been killed recovered afterwards, it suggests that the different amount of success from the use of this remedy may depend in part on the strength, but also on the Aphides being well washed down by syringing, or otherwise cleared from the shoots whilst they are still stupefied.

Very many different kinds of washes have been recommended for destroying Green Fly, of which recipes for some

* For references to soft-soap washes and emulsions, see Index; details regarding methods of mixing, proportion of ingredients, &c., were given, and also cautions about experimenting as to strength before using the applications on a large scale, as the strength desirable or safe for use varies sometimes with the nature of the plant, and likewise depends much on the age of the leafage.

of the most well-proved as serviceable will be found noted under the headings of "Prevention and Remedy" of Hop Aphis, and other kinds of Aphis attack, and some under the heading of "Winter Moth," but the same principles of application run throughout, namely, to get rid of the Aphides either by heavy syringings that fairly sweep them, or many of them, down; or by poisoning them, or coating them with sticky matter that will kill or injure them; or by making the surface of the leaves and shoots distasteful to them. With a foundation of soft-soap, and a small addition of anything poisonous or deterrent according to fancy, each cultivator may make for himself at a small cost a thoroughly serviceable wash.

"**Shot Borer.**" "**Apple-bark Beetle.**" "**Pear Blight,**" *Xyleborus dispar*, Fab.; *Bostrichus dispar*, Fab.; *Xyleborus pyri*, Peck (of American writers).



Xyleborus dispar: Male and female beetle, magnified; lines showing nat. length. Plum-stems, showing horizontal and perpendicular galleries.

The following observations refer to the serious, and often rapidly fatal, injury caused to young Plum trees by the *Xyleborus dispar*, or "Shot-borer," a very small dark brown beetle, which until last year (1889), had been considered to be

one of our rarest species, although on the Continent it has been recorded as occasionally doing enormous mischief to various kinds both of young orchard and forest trees.

The injury is caused by the beetles driving their tunnels, so as in the case of quite young trees to partially ring them, and also to clear out an inch or so of the central pith; in the older, though still far from full-grown, trees, although the borings were not so regularly placed, still, from their large number, they interfered with the passage of the sap and did great harm.

The first observation of its presence was sent me from the Toddington Fruit-grounds on September 1st, by the Deputy Superintendent, Mr. Charles D. Wise, who reported as follows:—"I enclose a portion of the stem of a young Plum tree, in which you will see a small beetle, which has bored its way into the wood, and killed the tree. We are losing several trees from the same cause."

On examination I found that the cause of the injury was the "Shot-borer" Beetle (as it is called in America). These beetles are of a pitchy-brown or pitchy-black colour; the wing-cases are of a redder brown in the male than the female. The fore part of the body behind the head is granulated; the wing-cases have alternate rows of fine punctures, with flat spaces still more finely punctured, and rows of hairs. The horns are clubbed at the ends, and, as well as the legs, of some shade of yellow or reddish tint.

The great peculiarity of these insects is the difference in shape and size between the male and female (the *disparity*), from which the beetle takes its name of *dispar*. The female is about the eighth of an inch long, narrow and cylindrical, with the thorax (the fore body) large in proportion, and raised in the middle so as to make a kind of hump. The male is only about two-thirds of the length of the female, and much wider in proportion, and the back is flatter. The wings which I examined in the female were well developed, and thickly sprinkled with very short, bulbous-rooted bristles.

The reason of the singularly rapid and complete destruction of the stem of young trees attacked by these beetles was plainly shown on laying open their tunnels. In the specimens of these from Toddington which I examined (figured life size opposite), I found that the injury began by a small hole like a shot-hole being bored in the side of the attacked stem, from which a tunnel ran to the pith, and a branch about the eighth of an inch across ran horizontally about half or two-thirds round the stem. Sometimes this tunnel was about midway between the outside and the centre, but in one instance quite at the outside of the wood. From these horizontal borings

other borings were taken straight up and down the stem; these might be certainly as many as four (perhaps more in one stem), and were from half an inch to upwards of an inch and a half long, and of these tunnels (in the pieces of stem I examined), one ran along the pith, which was completely cleared away. The great injury caused by these galleries fully accounted for the death of the stem.

At the time of examination, that is, on or about September 12th, the tunnels were filled with beetles; where the width only was enough for one, the beetles were arranged in a row one after another in procession, as it were; where the tunnel was a little wider (as where the pith had been cleared away), they were less regularly arranged, but crowded in, so that there scarcely seemed to be room for another. In one length of wood of about two inches I found, as near as might be, thirty beetles. The work of destruction was still evidently going on, for in some instances I found that, instead of being as usual black and discoloured, the sides of the tunnel or the extremity were white and moist, showing the beetles were still feeding. The instinct of tunnelling was so strong at the time, that a quantity of beetles which I secured in a tube buried themselves so rapidly in the cork, that between the 10th of September and the morning of the 12th they had already bored five tunnels into it, and it contained at least seven female beetles.

A great peculiarity of this attack has been considered to be the extreme rarity of males compared to the number of females, and amongst from about fifty to sixty of these Shot-borers which I took out of their borings in Plum stems in September, I found only one male. Subsequent search, however, made me think that in winter the difference in proportion of numbers would be found to be not nearly so great, for amongst some specimens I examined early in December I found a larger proportion of males, and about a month later, amongst specimens I took (on or about January 10th) from a piece of Plum stem two inches and a quarter across, about seventeen males to six females.

The borings at this winter time of year only contained a sprinkling of beetles, instead of, as in September, being so crowded up that there was scarcely room to insert another beetle into the row that filled each boring.

The method of attack is stated, by the well known German observer Schmidberger, to be for the beetles to choose a spot, usually on the main stem of the tree, making no distinction as to the tree being sickly or healthy, young or old, so long as it is thick enough for the purpose,—at least half an inch in diameter. (The attacked stems sent me from Toddington were

from a little under to a little over three quarters of an inch across.—Ed.). The female then proceeds to bore passages, and in a small chamber at the opening of each of these she is stated to lay her snow-white, longish eggs. The first-hatched larvæ are recorded by Schmidberger as being noticeable about the end of May, and these are considered by him to arrange themselves (in the same manner as the beetles we noticed as above described) one after the other in the tunnels so as to fill them, and to feed there on a whitish substance with which the passage is encrusted, and there the maggots, according to the observations quoted, turned to chrysalids and thence to beetles.*

The method of feeding of the maggots is more fully described by Herr W. Eichhoff, Imp. High Forester in Mulhausen, Alsace, as follows :—" The *dispar* only uses the wood which is still fresh, and full of sap for the brood; this sap soaks (' sweats ') so constantly out of the walls of the breeding galleries, that presently this thickens into white-of-egg-like coagulations (called by Schmidberger ' Ambrosia ') ; and from these the coatings of fungi which have been so often mentioned develop, whereby after a time the surface of the circular galleries become stained black. These coagulations, and occasionally the fungoid growths, serve exclusively for the nourishment of the young larvæ.†

As yet the only observations which I have received of severely injurious presence of the Shot-borers in this country have been from the fruit-grounds at Toddington, near Cheltenham, and from various localities not far from Kidderminster, and the only trees which suffered in these cases were Plum trees.

In Germany it has been recorded as seriously injurious to young Apple trees, also as breeding in the stumps of felled Oaks and Beeches, and in fallen trees ; and in America this same species of beetle, commonly known there under the scientific name of the *Xyleborus pyri*,—popularly as the " Pear Blight " or Shot-borer Beetle, is recorded as injurious both to Pear and Apple, as well as occasionally to Apricot and Plum.

Prevention and Remedies.—Where the trees attacked are still young (that is still only, as was the case at Toddington, about three-quarters of an inch across the stem), the only

* *Bostrichus dispar*, Schmidberger (*Apate dispar*, Fab.); *Xyloterus dispar*, Erichson. See ' Naturgeschichte der Schädlichen Insecten von Vincent Kollar,' pp. 261—273, and English translation ' Kollar's Treatise on Insects,' pp. 254—262.

† ' Die Europäischen Borkenkafer,' von W. Eichhoff, Kaiserl. Oberförster in Mulhausen, Elsass, Berlin, 1881.

course to be advised is to cut them down as soon as they are found to be infested, and to burn the part containing the beetles. It is no waste, for in the case of young trees the beetle-borings are rapidly fatal.

For treatment to prevent beetle attack to the growing trees, the only generally available measures appear to be those suggested by Mr. J. Fletcher, Dominion Entomologist of Canada, for use in the Nova Scotia Apple orchards, namely, of coating the trees with some wash or mixture which will not hurt the bark, but will prevent the beetle getting in or getting out. One application advised for trial is a thick coat of white-wash with some Paris-green in it.

Another is the thick soft-soap wash known as the "Saunders' Wash," thus noticed :—"Soft-soap, reduced to the consistence of a thick paint by the addition of a strong solution of washing-soda in water, is perhaps as good a formula as can be suggested; this, if applied to the bark of the tree during the morning of a warm day, will dry in a few hours and form a tenacious coating not easily dissolved by rain."*

Where infestation is known to exist in a district, just the same class of measures are useful to prevent its continuance which are in regular use by foresters for prevention of infestation of Pine Weevil and Pine Beetle in woods and plantations.

I take the information from Herr W. Eichhoff's paper above quoted.

The Shot-borer frequents stumps or fallen trees of the kinds liable to its infestation, for breeding purposes, and prefers these (where attainable) to healthy growing material. Therefore it is desirable to remove all such material and burn it early, that is, by the beginning of the warm season; and later on, at the time of summer felling, to remove and burn all infested wood. Further, it answers to set trap wood. These traps are poles of any suitable kind of wood, having one end set in the ground so that they may keep fresh all the longer. These are to be set from spring till autumn, and examined every few weeks, and (if found to be pierced) burnt. New pieces should be set from time to time, as the beetles require wood with some degree of freshness of sap for their breeding purposes.

Where wood yards are near orchards it is important to be sure that the timber lying in them is not infested by the Shot-borer, for in such case it is sure to be a centre of fresh infestation.

* Report of 'Entomologist' Department of Agriculture, Canada, 1887, p. 28.

March Moth. *Anisopteryx æscularia*, Schiff.

March Moth; winged male, wingless female, and band of eggs.

The "March Moth" is a common kind, and, as described by its name, is to be found early in the year. In 1889 specimens of the wingless females, together with bands of their down-embedded eggs, which they were then laying on Plum twigs were sent me on the 29th of March. The moths were about three-eighths of an inch long, brown or fawn-colour above, shading to grey below, with darker head and eyes, and dark pencil of hair at the end of the tail, and might be generally described as thickly pear-shaped (the pencil of hairs at the end of the tail answering to a broad, short fruit-stalk—see figure). The hairs were long, the six legs very long, and the moths, though sometimes quite quiet, were able at pleasure to walk very rapidly; one that I timed as to speed walked the length of six inches in twenty-five seconds. The wings were to all appearance totally absent, and the downy coating of the moths very smooth and silky.

The twigs were quite small (none of them as much as a quarter of an inch across), and the bands of eggs which were then laid (or being laid) varied from about a quarter to half an inch in breadth at the widest part, but did not always quite encircle the stem. They were deposited with beautiful regularity, and showed to the naked eye as if laid in almost precisely parallel rows along the twig, and were embedded in down supplied by the parent moth from the pencil at the end of her tail. In the largest band I counted twenty-nine rows, and as each of these rows (as nearly as I could count or estimate) was composed of upwards of eighteen of the bright, shining eggs, the whole number in this ring would be well over five hundred.

The "looper" caterpillars which hatch from these eggs are of a light or whitish or clouded green, with a white or lighter line along the side, and (lower down) "a brighter and more distinct pale line in the region of the spiracles." These caterpillars feed on many kinds of trees, but are noted by German observers as being particularly injurious to Plum trees. When full-fed, they turn to chrysalids "in or on the

ground," and, according to Dr. Taschenberg, in a loose web. The moths appear in March or April. The male moth is winged, and of the size and pattern figured at p. 335; the upper wings marked with various transverse bands or lines of brown or paler tints; the hinder wings paler, with a zigzag line.

Prevention and Remedies.—For prevention of attack of this moth, it might be hoped that as the chrysalids lie in *or on* the ground, thorough disturbance of the surface during winter, or before developing time in spring, would do good. In this way they would be turned out of their self-arranged shelters to alternate cold and wet, which is an excellent method of lessening amount of insect vermin.

Another means of prevention, in the case of trees where the end twigs are *in sight and in reach*, is looking towards the end of March or in April, to see whether the ends of these twigs are infested by the bands of wool-embedded eggs, and, if so, having these cut off and destroyed.

On large orchard trees many of the twigs would be too high to see or to reach conveniently, but in very many cases the use of a light, long-handled pair of very small-bladed shears or nippers would get over all difficulties; a small hawk's-bill pair of nippers, with light handles about six feet long (such as I have myself been in the habit of using), would reach to a fair height, and do the work well and neatly. Two or three feet more at least might be gained, without going to the expense of any special apparatus, by having a bit of board laid across the top of a little hand-cart, which the operator could himself move without difficulty round the trees. This would furnish him with a stage or platform from which he could easily reach to about thirteen feet or more from the ground. The prunings of course should be burnt.

Mottled Umber Moth. *Hybernia defoliaria*, Linn.

The Mottled Umber Moth; male, and wingless female; caterpillar after Taschenberg.

The caterpillar of the Mottled Umber Moth is a "looper," like that of the Winter Moth noticed in the next paper, but is somewhat larger, and may be easily distinguished by its peculiar colouring.

It is of a clear or reddish brown above, "this area is bounded on each side by a very distinct but narrow waved black stripe, and is also adorned with grey markings;" "below the boundary the body is bright yellow; the spiracles are white, and the region surrounding each spiracle brown; the belly is greenish yellow; legs and claspers pale."

Like others of the caterpillars specially known as "loopers," it has, instead of four pairs of "sucker-feet" below the body, only one pair besides the pair at the end of the tail; so that in walking it cannot progress forward continuously, but has to bring the sucker-feet and tail-suckers forward to where it is held firm by the claw-feet (as shown in figure, p. 336), and thus it forms an upright "loop," whence the name of "looper."

The caterpillars are very abundant, and very injurious to leafage of various kinds of fruit and forest trees, and have been especially noted as feeding at times on unripe cherries, gnawing away one side of the fruit.

When full-fed, which may be during June, or even a little later, the caterpillars turn to chrysalis on or a little under the surface of the ground. From these caterpillars the moths come out in October or November, about the same time, that is, that the Winter Moths appear. Like them, the male moth only is winged. This is of the size and appearance figured, that is, about twice the size of the Winter Moth; the fore wings are usually of a pale brown or reddish yellow, with dark transverse bands, and "between them is a dark spot in the middle of the wing. The hind wings are rather paler, and have a brown spot near the middle; all the wings are more or less sprinkled with brown dots." Sometimes, however, the wings are merely of a reddish brown freckled over with minute dots.

The female moth is of a wainscot-brown colour, with two very conspicuous dark spots on the back of each segment. The wings are so abortive as to be almost invisible.*

The caterpillars are often sent me amongst other orchard pests, and are very easily recognisable by their gay and peculiar colouring. The female moths also are easily distinguished by the brown spots on their backs from the females of the Winter and March Moths.

All the measures which are recommended in the following

* The above descriptions of the appearance of the moths and caterpillar are almost entirely taken from Edw. Newman's 'Brit. Moths,' p. 105.

paper, for prevention and remedy of infestation of Winter Moth, are equally desirable for prevention of damage from attack of Mottled Umber.

Winter Moth; Evesham Moth. *Cheimatobia brumata*, Linn.

Winter Moth (*Cheimatobia brumata*): male and wingless females.

The "Winter Moth" is not quite accurately described by either of its English names, for though it may be found in great numbers, still going up the trees towards the end of November, yet precautions against it (if they are to be of real service) should be taken fully five weeks earlier; and though a notable pest in the neighbourhood of Evesham, it is by no means confined to that district. Also some amount of appearance of the moths is to be expected about the end of March.

It is perhaps the most injurious of all our orchard insects. The caterpillars prey on the leafage and buds of Plum, Apple, Pear, Cherry, and other fruit trees, and during the last few years have been recorded at the Toddington Fruit-grounds, as likewise infesting the Currant bushes planted beneath the orchard trees.

The male moths are of the size here figured; the fore wings ash-grey, or of a grey-brown with an ochry tinge, marked with several transverse bars or bands; the hind wings pale, or of a greyish white.

The female moths are dusky grey, not absolutely wingless, but furnished merely with abortive wings too small to be of any service in flying. The fore pairs are marked with two cross streaks on each, the hinder pair with an indistinct streak. The abdomen is very large in proportion to the fore body, so as with the long legs to give the insect very much the appearance of a spider.

About the middle of October (one of the earliest observations of capture sent me was the 19th of the month) the female Winter Moths come out from the chrysalis cases beneath the trees, where they developed from the caterpillars that went down in summer, and creep up the stems to lay their eggs.

The moths are most active from sunset, or rather before it, till late in the evening, and the males are stated to appear a few days before the females. If this is so, it would be a convenient guide as to time being come for sticky banding.

The female moth creeps up the tree and lays her eggs on buds or twigs, or in crevices of the bark, and from an enormous collection of trimmings from Pear trees (the result of three men's work during three hours, sent a little after the 10th of March, by Mr. C. Lee Campbell, of Glewstone Court, near Ross), it was made very plain that the moths particularly selected the little furrow between the wood and the bark where shoots had been cut back for egg-deposit; at the truncated end of these cut back twigs, or small boughs, the Winter Moths had laid their eggs in such numbers that the little specks could be seen with the naked eye, arranged so as to form a ring more or less scattered just inside the bark, which had healed since pruning, and so made an outside line of protection to the eggs. This will be found excellently figured in a paper on "The Caterpillar Scourge," in the 'Journal of Horticulture' for June 5th, 1890 (Fleet St., E.C.).

The eggs when laid are stated to be greenish white, but to become orange and subsequently brown before hatching: my own observations began in the second week in March, when the eggs were changing from their reddish colour to the tint that *immediately precedes* hatching. On the 11th of March, Mr. J. Garrood, of Ledbury, had kindly furnished me with a small bundle of Apple twigs, which had been placed in a box in the autumn preceding, with a number of Winter Moths, male and female; the eggs deposited on the spurs sent me being the eggs of the Winter Moth. On the 26th of March many of the eggs had hatched.

These eggs were bluntly oval, or cylindrical, rounded at each end, about the 32nd of an inch in length, and the width about two-thirds of the length. The skin was pitted over the surface; with the help of a moderate magnifier it had the appearance of being shagreened; under a one-inch power the markings showed as circular depressions so regularly placed as almost to give a honeycomb-like appearance. Some of the eggs were still of the pale reddish tint of which they all appeared to be when sent me; a few were of green tint, this apparently from the colour of the caterpillar within, now near development, showing through the filmy egg-skin; and the many empty egg-shells were now (when seen through a magnifier) mere iridescent films, almost glassy in brightness. To the naked eye they gave the appearance of the parts of the twig on which they were placed being beset with little patches of

greyish or bluish mould, or of the down natural on some kinds of Apple twigs.

At this date—that is, on the 26th of March—the caterpilars, from the eggs sent me by Mr. Garrood on the 11th, were perfectly active, moving about characteristically in loops, or placing themselves erect on their sucker-feet. The colour was dingy green or grey; heads black, thus agreeing specially in this point with the observation of Dr. E. L. Taschenberg, that after the first moult the caterpillars have black heads (as well as a black spot on the nape of the neck). Thus, with the guidance to identification given by Mr. Garrood's specimens, clearly known to be eggs laid in confinement by isolated specimens of Winter Moths, we make the great step onwards of being able to distinguish whether there is infestation of this kind present on the boughs, and to prepare accordingly.

With the guidance given by these specimens, I examined portions of the very large collection of egg-infested cuttings from Pears above alluded to, kindly placed in my hands by Mr. C. Lee Campbell, and found the eggs to be precisely similar in every respect. The eye was similarly attracted by the little bright or whitish mould-like spots, and (similarly) I found empty egg-shells, and greenish eggs and some still reddish. The eggs had similar inequalities on the surface, and the little looper caterpillars were similar in appearance, and, though hardly the sixteenth of an inch in length, were when disturbed already able to spin a thread to attach themselves by.

A few days later—on the 31st of March—I found many of this collection of eggs were changed from the reddish colour to a variable iridescent tint, grey or bluish, or occasionally greenish, according as the light fell upon them.

One of these eggs I punctured, and watched the caterpillar emerge; and this larva, and another that I watched in natural process of emerging, appeared to me indistinguishable from young Winter Moth caterpillars; and at this date I found many little caterpillars, apparently almost all little Winter Moth grubs, on the paper on which I threw out the twigs, these varying in tint, as is frequently the case with this variable kind. Some were of different shades of greyish or greenish grey and one little larva was almost black.

This kind of caterpillar is described by Edw. Newman, in his 'Brit. Moths,' as being very variable, sometimes green, sometimes smoky brown, sometimes approaching to blackish.

They not only are variable in colour one from another but they also change in appearance after each moult. The

following is just a short general note of these changes, taken from Dr. Taschenberg's more detailed description.

When hatched they are greyish, afterwards of a yellowish green, faintly striped with white along the back, and with dark head and mark on the neck. Afterwards the dark colour is thrown off, the green is of a clearer tint, and the white stripes plainer, and after the last moult the caterpillars are of a yellower green, with a light brown shining head. A stripe of darker colour down the back is probably (or, at least, in part) from the food showing through the skin. When full-grown they are about an inch long.

Whilst still small and weak the caterpillars attack the most tender part of the young growths, but gradually (in bad cases) sweep everything eatable—buds, flowers, leaves, or growing fruit—before them, until the ravaged tree, with the remains of brown spun-up knots of leaves on it, looks as if it had been scorched by fire. They prey on many kinds of trees besides the orchard trees, where they are especially injurious to us; and when full-fed, which may be from the middle to the end of May and sometimes as late as June, they leave the trees (as far as is recorded, by letting themselves down by their threads) and go down into the ground, where they turn to chrysalids near the surface, from which most of the moths come up in autumn.

Some of the moths, however, remain in the chrysalis state during winter, and do not come out until the following spring; and the brood from these spring moths coming later than the others accounts for the succession of appearance of young caterpillars sometimes observed.*

THE READER WILL PLEASE TO OBSERVE, *that the following long observations on means of prevention and remedy of damage from Winter Moth, are placed under this heading because not only are those named of service in counteracting this attack, but also the different classes of treatment mentioned are serviceable with regard to many other kinds of attacks, and are therefore given in detail here, with references to them throughout the volume, to save repetition.*

The "greases" or "lubricants" are of use in stopping traffic of wingless pests; the various kinds of soft-soap and mineral oil emulsions are useful as "washes" or "sprays," in many kinds of attack, to leafage or branches; and the Paris-green, as being newly introduced as a satisfactory caterpillar remedy (when used

* For good accounts of the life-history of the Winter Moth see 'Praktische Insekten-Kunde,' by Dr. Taschenberg; likewise the account in 'Brit. Moths,' by Edw. Newman, and likewise that given in Kollar's 'Insects Injurious to Gardeners, Foresters &c.'

with the precautions and in the exceedingly small proportion named), is entered on in detail, in order to give all requisite information from the Reports of the Departments of Agriculture of Canada and America on this subject, of which Bibliographical references are given at the end of this paper; and the recent searching trials of our own Fruit-growers' Conference at Evesham, are also appended.

Prevention and Remedies.—The points to be considered lie under three main heads:—1st, how to keep the wingless moths from gaining access to the trees for egg-laying; 2ndly, if eggs are laid, how to destroy them or lessen their numbers before hatching-time; 3rdly, if caterpillars appear, how best to get rid of them without injury to the leafage of the infested trees.

In order to keep the wingless moths from gaining access to the trees, various kinds of apparatus have been recommended, both in Germany and America, for stopping the moths,—some of wood, some of bands of tin applied in various ways,—but there are various objections to the use of these (at least so it appears to me), partly from the care that has to be taken to prevent harbourage of eggs, &c., beneath them, and partly from the greater expense; but if details are desired, I will give information and a working drawing of the most approved form, as noted in the U.S.A. report below referred to,* to any applicant. In this exhaustive report on "Canker-worms," by Prof. Riley, almost every point appears to be entered on which may be of service for prevention of attack similar to that of our Winter Moth, and various sticky mixtures are mentioned and methods of applying them, but the principle is the same as that of our own treatment. Anything that is sticky enough to keep the moths from going up the tree, and which can be so *applied* as *not to hurt the bark*, will answer, whether it is tar, tar and oil, resin and oil, bird-lime, printer's ink, slow-drying varnishes, or anything else. Only, what is at hand, cheap, and has been proved to be effective, is best; and, so far as appears at present, none of the extra-British methods of preventing the wingless moths gaining access to the trees are to be preferred before the methods of application of the plan of grease-banding, or of sticky-banding, which have been worked forward by the attention of some of our own leading fruit-growers, so as to be easy and cheap of application, effective for purpose needed, and also (which is a most important point), so managed in the laying on as *not to injure the bark*.

* Much useful information relatively to this class of attacks, and means of prevention, is given in the chapter on "Canker-worms," pp. 157—197 of the 3rd Report of the United States Entomological Commission published by the Department of Agriculture, Washington, U.S.A., 1883.

Two of the most important points to be considered in "Sticky-banding" trees are:—(1st) What material is best to use in order not to hurt the trees, or (if it is of a hurtful nature) how best to prevent it soaking into the bark. (2ndly) What time or times of year the "smear" should be applied.

With regard to the material to be used, the following notes show that cart-grease answers the purpose of *catching the moths* thoroughly well, but also that (what is called) cart-grease may be so mixed with tarry or other matter deleterious to the health of the tree, that it is requisite for all orchard-growers to ascertain what the application sold them is made of.

On December 1st, 1888, I was favoured by Mr. Charles D. Wise (Deputy Manager of the Fruit-grounds at Toddington, Winchcomb) with the following note regarding commencement of operations. This report shows the large scale of the operations, and their success in preventing the ascent of the moths, and likewise warns against the use of tar. Mr. Wise wrote:—"I think you will be interested to hear that we have caught millions of the wingless moth this season. As many as 500 have been counted caught in the band of grease on a single tree. As we have something like 100,000 trees, it has been a great business putting the bands on and keeping them sticky. We have tried many different mixtures, but on the whole I have found cart-grease by itself, put on *thick*, answers best; it is cheapest, and, I think, does no harm to the tree." "Where tar has has been used, I have found the tree alive up to the place where the band was put on, but above the band dead." And in another letter Capt. Corbett (Manager) further wrote on the same subject:—"Please note I have discarded tar, for I have found instances where, even when mixed with grease, it has, on drying, formed a tight band round the bark, and destroyed the tree."

The following valuable observation on the subject of nature of grease or material used for banding, and necessity of protecting live bark from being choked by smears, was also kindly placed in my hands by Mr. J. Masters, of Evesham, Hon. Secretary of the Fruit Insect Conference Experimental Committee . . . "It is most important to be guarded in buying grease. Some dealers offer you a cheap article, and it is a vile compound of injurious mixtures. Get a good article, free from tar, if you pay more money for it, is my advice.

"I should recommend in all cases where there are young trees, and where the bark of the tree is smooth and tender, that grease-proof paper should be first banded round the tree and the grease put on the paper. But on old trees where the bark is rough, I do not think that grease (*good*) would be

injurious. Trees should be daubed not later than the middle of October. A good daub should be used, and looked after that it is kept moist and adhesive, otherwise moths will cross over it."—(J. M.)

These points need very careful attention, for though it is very possible that on old trees (where the thickness of the bark protects the vital layer of young bark and wood forming beneath almost as effectually as if a cradle of pieces of cork was fastened round the tree) there may be no damage caused by tarring, this is very different to making use of it on young trees, where, as it has been very well described, it fairly "*waterproofs*" the sodden tissues, and I believe myself that tar should not be used on young bark, and in any case should be used with care and caution.

With regard to cart-grease itself, so far as a regular form can be given, it appears to be usually compounded of tallow, palm oil, and soft-soap, or, what comes to the same thing, tallow, palm oil and water, and caustic soda. The following notes of the ingredients of some of the mixtures or preparations commonly made use of or sold under the names of "waggon-axle" or "railway grease" may probably be of service in showing the ingredients of the ordinary compositions, and also that some of the additions or special makes for suitable special machine use are by no means what can be recommended for spreading at haphazard on living vegetable tissues.*

Of two kinds of railway or waggon grease mentioned in the work below quoted, one consists essentially of a mixture of a more or less perfectly-formed soap, water, carbonate of soda, and neutral fat, whilst the other is a soap of lime and rosin oil, with or without water. Frazer's axle grease consists of rosin oil of various numbers, saponified with a solution of sal-soda in water and softened lime; and these two rosin recipes are apparently very similar to a composition used with success at Toddington.

Some other mixtures are merely of greasy or soapy compositions; one is of tallow and palm oil melted together and mixed with soda; two others are of palm oil and tallow for the foundation, mixed respectively with sperm oil and caustic soda, or with rape-seed oil and soda; another, the "Austrian railway grease," is of tallow, olive oil and "old grease."

So far, there would be nothing deleterious to bark beyond what injury may occur from grease gradually soaking into the tissues, but a preparation of "axle grease," composed of black oil or petroleum residue, animal grease, powdered rosin added

* See pp. 376—379 of paper on "Lubricants" in 'Workshop Recipes,' by C. W. Warneford Lock, published by E. & T. N. Spon, Charing Cross, London.

to soda-lye, and salt, would be highly undesirable to smear on unprotected bark.

I have had notes of Davidson's composition being very serviceable for smearing.

Guarding the bark.—Where bark is thick and dead on the outside, as on old Apple trees, or where dressing is chosen of some kind which will not sodden into the tree in the heat of the sun, it *may* (as above mentioned) do no harm if smeared on to the unprotected bark. But where year by year the smear must be kept on for weeks in autumn and winter, and very possibly have to be applied again towards the end of March, to stop the ascent of the spring brood of the Winter Moths, and also the wingless females of the March Moth, some protection is needed. If this is not given, the grease will soak into the cells and stop the passage of the sap, and the tree will die.

At present the simplest and cheapest, and also most successful, plan that I have notes of is that which was largely used at Toddington last autumn. The material employed is the kind of tough paper which is made use of by grocers for wrapping up butter, lard, and the like, and is known as "grease-proof" paper. This is applied by a band as many inches wide as is thought fit (the wider the better) being passed round the stem of the tree. The band should be cut long enough for the ends to overlap well, and these are fastened by paste, and the whole is made secure by a piece of bast-mat or anything that will not cut the paper, being tied round the paper near each edge. This work can be rapidly and well done by women. On the paper bands the grease or application may be spread in any way preferred, but the best way is considered to be to lay it on with a thin, flat bit of wood, and plentifully, both as to width of band and thickness of layer. In this way (when I saw the managers in the autumn), 80,000 Plum trees and about 40,000 more of other kinds were being treated at the Toddington Fruit-grounds, near Cheltenham.

A slightly different method of banding was tried, also with good success, by Mr. E. R. Cheesman, of Bough Bridge, Edenbridge, Kent, of which he gave me the following note:—

"Now the course I have followed is this: I have first placed bands of impervious paper (such as is used by grocers for butter and other greasy substances) of about seven inches in width round the trees, a foot from the ground, first removing loose and rough bark so that the bands should lie quite close; on this I have placed a similar width of glazed lining-calico, and tied tightly with strong string at an inch from both top and bottom of band, so that wind or rain cannot move it in

the least; I have then used a mixture of cart grease and soft-soap, mixed to the required consistency with train oil, and laid on to the bands with ordinary paint-brushes; this was done by October 16th, and they have been served in the same way every week since, so as to keep them always sticky. . . . We have caught some thousands of both the males and females (which seem to keep together) of the *Cheimatobia*, a few of a much larger sort of moth, also wingless or nearly so (probably Mottled Umber.—Ed.), but these latter are not in any quantity here; I may add that in very few cases have any of the moths got as far up as the middle of the band, and I am fairly satisfied that we have caught all that had attempted to ascend. This mode is a little trouble and expense, but the latter does not exceed twopence per tree, even on full-grown trees, which most of mine are, many being very large ones, and this is a very trifling outlay, if a crop can be saved by this means."—(E. R. C.)

It is of great importance to begin the grease-banding in good time.

Captain Corbett reported to me from Toddington Fruit-grounds, from the experience of some of the foremen who had given special attention to date of banding, that "all trees greased before Oct. 17th were nearly free from caterpillar. Those not greased until Oct. 17th were infested with caterpillar." As a help to know when the moths might be expected to appear, Captain Corbett further noted:—"I would just add that another foreman kept some chrysalids of the Winter Moth in a box last autumn, and on the first moth coming out he put the band of grease round his trees. His trees are for the most part thickly laden with Plums."

Taking various reports sent me, it appeared that presence of wingless moths was observed at different dates from October 11th to November 19th, at which time the Winter Moths were still going up the trees in large numbers; therefore during this period, and as long as examination shows that moths are still being captured, care should be taken that all the bands are soft and sticky.

Stakes and tree-guards need attention.—Where young trees are fastened to stakes, something of course must be done to stop traffic up these poles or stakes and thence to the trees; and where bundles of rough sticks are tied round the stems to prevent these being gnawed by animals, these guards will also probably be a most fertile source of caterpillar-attack at hatching-time in spring, unless well looked to. For stopping traffic up the guards or stakes tar would do very well, but it would be difficult to apply any treatment that would not be very troublesome to the bundles of sticks. In such cases, banding

above the sticks, or the attachment of the guards, is the safest course.

By means of the grease-banding, vast numbers of moths were stopped in their upward traffic, wherever the plan was properly carried out; still the difficulties have to be watched for and remedied, which were laid before me in 1889, by Mr. Sutherland, chief reporter to the 'Worcester Herald,' relatively to *passage of stray moths across the sticky bands, and passage of caterpillars in spring over the dried bands.*

"It is now suggested that a wider band of the grease-composition is necessary, and that it should be supplemented by lime-washing the trunks in spring. One grower tells me that he captured thousands of moths on the grease-bands last autumn. Some, however, were quite on the upper edge of the band, which may be taken as an indication that some others got over the grease altogether. On the other hand, other moths, after going a short way in the grease, turned back, and laid their eggs on the trunks of the trees below the band. Tiny caterpillars have been discovered on the trees over the grease, showing that they must have been hatched in the upper part of the tree; and again it is suggested that the fully-developed eggs in the dead bodies of the moths captured on the grease-paint may be hatched, notwithstanding their position."

Capt. Corbett also mentioned:—"We put bands of grease in the autumn round our Plum trees (we do not like *tar*), and killed thousands of moths; still a few eggs are to be seen on the branches, and a good many *below* the band of grease. We are dealing with them now in this way: we mix up a quantity of clay (as the basis), well tempered with soot, lime, cow-refuse, and water, and paint the whole of the stem of the trees with it, working it well into the cracks, and we hope that this will destroy the eggs." Capt. Corbett also placed in my hands a slightly different recipe, which was used similarly to the above, that is, the trees were painted with it in March from the ground to the branches. This consisted of well-mixed clay, 4 parts; cart-grease, 1 part; and soot, 1 part.

Soft-soap and mineral-oil washes and emulsions.—On application to Mr. J. Fletcher, Entomologist of the Dominion of Canada (requesting his advice as one of the very best authorities, as to prevention of caterpillar attack), regarding the surest way of destroying eggs left as above noted, he wrote as follows:—"For washing the trunk, to destroy all eggs which may have been laid during the winter, a kerosene emulsion may be used. This should be done in the end of March."—J. F.

The following recipes give directions for preparing the emulsion, and with us paraffin oil may be substituted for kerosene oil throughout:—

Kerosene and Soap Mixture.—"To make this I use one-fourth of a pound of hard soap, preferably whale-oil soap, and one quart of water. This is heated till the soap is dissolved, when one pint of kerosene oil is added, and the whole agitated till a permanent mixture or emulsion is formed. The agitation is easily secured by use of a force-pump pumping the liquid with force back into the vessel holding it. I then add water, so that there shall be kerosene in the proportion of one to fifteen."—(Prof. A. J. Cook, in Bulletin 26 of the Agricultural College, Michigan, U.S.A.)

I give the above recipe first, because, being noted as a satisfactory application for the Apple Aphis, it may be presumed the proportion of kerosene would not be enough to injure ordinary bark; but all experimenters should bear in mind that the strength and amount of mineral oil used must be well considered, and the same strength may not be safe on all parts of young trees, or on all conditions of leafage.

Another recipe is for "Kerosene Emulsion" of the ordinary strength for general application, *viz.*, kerosene or refined coal oil, 1 pint; common laundry soap ½ oz.; rain-water ½ pint. The soap was boiled in the water till all was dissolved, then the boiling soapsuds were poured into a watering-pot containing the kerosene, and churned with a garden-syringe until the emulsion was complete. This generally takes about five minutes, but sometimes longer. When this emulsion is made, it can be bottled up for future use. When using it, either as a wash for sponging trees or for spraying, it must be diluted with nine times the quantity of water. Should the oil in the emulsion after a time separate, it is well to warm it, and by violently shaking the bottle it will again become fit for use. In diluting the emulsion use warm water. See p. 14 of 'Report of Entomologist and Botanist, Department of Agriculture, Canada,' 1887.

The following recipe is one of the Department of Agriculture of the United States of America. In this the plan is to add one gallon of water in which a quarter of a pound of soft-soap (or any other coarse soap preferred) has been dissolved, boiling or hot, to two gallons of petroleum or other mineral oil. The mixture is then churned, as it were, together by means of a spray-nozzled syringe or double-action pump for ten minutes, by means of which the oil, soap, and water, are so thoroughly combined that the mixture settles down into a cream-like consistency, and does not, if the operation has been properly performed, separate again. This is used diluted with some three or four times its bulk of water for a watering; if required for a wash, at least nine times its bulk is needed—that is, three gallons of "Emulsion," as it is

termed, make thirty gallons of wash. Warning is given that care must be taken with each new crop to ascertain the strength that can be borne by the leafage, and this equally applies to all applications to live bark.

Soft-soap and paraffin oil wash.—The following recipe, which was used by Mr. Ward, Superintendent of the Gardens at Stoke Edith, Herefordshire, in 1883, as a Hop-wash, is a much simpler form. As this was found to kill the Aphides without injuring the Hop plant or the burr, it might be considered quite safe as a bark application, and more of the ingredients might be added, as thought desirable. The proportions for large quantities are 12 lbs. of soft-soap and half-a-gallon of paraffin oil to 100 gallons of hot water; the nearer to boiling the water is used the better the paraffin mixes. This mixture should be stirred well together, and used when cool.

The above applications may be used so as to destroy the eggs laid on the bands or below them, and, without doubt, would also be of use in preventing *ascent* of much insect vermin; but there are two plain reasons for possibility of some amount of "loopers" being present in spring on the trees, notwithstanding careful autumnal banding. *One of these is that some of the Winter Moths may develop in spring instead of autumn*, and consequently, though few in comparison to the autumn numbers, they need watch to be kept by an examination of trees in the evening or after sunset, or by banding a few experimentally, and, if necessary, grease-banding again. This operation would also prevent ascent of the so-called "March Moth" (for fuller account of which see reference in Index).

Another point is the *transportation of the wingless female Winter Moths to the trees by the males whilst pairing.* This point was not sufficiently observed, until within the last two or three years, to be taken into practical consideration, but it bears to a very important extent on presence of attack.

The only method of meeting this difficulty appears to be the plan sometimes used of placing a light at night under an open shed, of which the lower part of the roof or boards are tarred or greased. This so far attracts the moths that it has been found to answer in some degree, and more elaborate arrangements on the same principle have been suggested; but the plan appears to me open to many objections, on the score of bad use that might be made of lights left unguarded at night, and at best is but a palliative.

Skimming off the surface-soil in autumn, and burning it so as to destroy the contained chrysalids, is a good remedy where it can be carried out, but unfortunately it is only now and then that this can be managed.

Mr. J. Masters (before quoted) gave me a good instance of the effects of this treatment. He mentioned a plantation of Plums which had been severely infested for years with caterpillar blight, and likewise so neglected that the ground was smothered with weeds and Couch Grass. In order to clear these Mr. Masters suggested that the land should be breast-ploughed and surface-burned. This was done in September, and in October and November the trees were greased, but no moths were caught, although on land adjoining, where no breast-ploughing had been done, moths were found by thousands.

Disturbing the surface-soil, so as to throw out the chrysalids, was a remedy suggested (some fifty years or more ago, by the Imp. & Royal Ag. Soc. of Vienna) as useful where it could be managed, but excepting in garden cultivation, or with very special kinds of cropping, it is difficult to carry it out.

Late pruning, and burning all the pruned-off shoots, is a very good practice, because the Winter Moth is considered to lay her eggs by preference towards the ends of the shoots; therefore where these are cut off and burnt, when the chief laying season is over, which might be put about the middle of December, much infestation is got rid of.

I had a very good note on this subject, on February 6th, 1889, from Mr. C. Lee Campbell, of Glewstone Court, Ross. In this, after some observations on attempted measures for checking infestation, he suggested a more effectual remedy—consisting in cutting off the ends of the branches on which the eggs have been deposited, and burning them :—"I have found that an enormous proportion of the eggs are deposited at the end of every branch pruned in the autumn, as much as fifty eggs being found on one branch. At a moderate calculation, my men have thus destroyed some 6,000,000 eggs on 5000 to 6000 Pyramid fruit trees within the past months, in addition to a very large number caught through greasing the stems."—(C. L. C.)

The above observations refer almost entirely to methods of prevention of attack of "Winter Moth," and "Mottled Umber Moth," which is almost precisely similar in its habits, or other destructive attacks caused by caterpillars of wingless moths, which obviously fall under the power of the same kind of preventive measures.

But now passing on to remedies which can be applied to the attack when the caterpillars are ravaging on the trees.

What we need is a "WHOLESALE TREATMENT" which may be brought to bear at one time on all the kinds of caterpillars alike, whether loopers, or web-nest making caterpillars, "Small Ermines," or "Tortrix" caterpillars, or any other of the

many kinds of pests which are alike in their habits so far as destroying the leafage of our orchard trees is concerned, and to destroy these surely, without injuring the foliage.

Jarring, that is, shaking the boughs so smartly that the caterpillars fall down, is a simple operation, and sometimes answers well.

Prof. T. Elliott, of the Weald of Kent College of Agriculture, wrote me that in this way five bushels of small green caterpillars could be collected in a day on a large fruit-farm.

Capt. Corbett wrote from Toddington, "that by shaking down the caterpillars into a sheet, one man collected two gallons.

The difficulty in this plan is from the chance of some of the dislodged vermin creeping away and going up the stem of the tree, or returning up their threads to the boughs. These points are met fairly well in the following method advised by the Entomological Commission of the United States of America, 1880—82:—"*Jarring and burning.*—The worms should not be allowed to reach the leaves, but, where this has been allowed, it is best to strew the ground lightly with straw on a calm day, give the tree a good jarring, which will suspend all the worms in mid-air, cut loose the suspended worms by swinging a pole above them, which breaks their silken threads and causes them to fall to the ground, and then set fire to the straw. A Canker-worm holocaust will be the result, and if this is done on a calm, clear day with a little care, the tree need not be injured."* The caterpillars may be prevented going back up the trunk of the tree by a hay-band or rough rag-rope with some tar on it being placed on the ground round it, or a circle of tar might be dripped on the ground or short Grass.

These, however, and many other remedial measures tried up to the beginning of the present year, have proved anything but wholly satisfactory. With orchard insects, as well as with other kinds of crop insects, it may be almost surely laid down that where the same crop is constantly grown, the insect-feeders on that crop may be expected to be there also in great numbers, and in the constantly increasing spread of the fruit-growing industry in this country it became a matter for very serious consideration of fruit-growers what course was to be adopted to keep down the regularly recurring orchard infestations.

What is required is an application cheap, sure, and which can be brought to bear at once, when the caterpillars are observed on the trees, and which will destroy them without

* 'Report of Entomological Commission, U.S.A., Department of Agriculture,' 1880—82, p. 191.

hurting the leafage; and for this purpose spraying with a very weak mixture of Paris-green, when applied according to the plan which has now for many years been in regular use in the United States and Canada, has been found, on thorough trial given it during the spring months, to answer very well in the Toddington Fruit-grounds and various other localities mentioned further on.

The use of Paris-green was first brought forward by Prof. Riley (now Entomologist of the Department of Agriculture of the United States of America), at the National Congress of the United States in 1872, as a likely means of destroying the "Cotton-worm" (the caterpillar of a moth which causes great injury to the Cotton crops), and the results of trial fully realised his expectations; but the great success which brought Paris-green before the American agricultural public, and gave it a place as a serviceable insecticide, which it has held ever since, was its effect, when other special measures failed, in destroying the hordes of the Colorado Potato Beetle.

Spraying with Paris-green :— On application being made, early in the present year, to Mr. Fletcher, the Dominion Entomologist of Canada, for advice regarding the best methods of prevention of orchard insect-attack (as being thoroughly acquainted both practically and scientifically with the extent to which the use of Paris-green had been adopted both in Canada and the United States), amongst other points of his reply Mr. Fletcher mentioned :—"In this country we have a moth with similar habits to your 'Winter Moth,' and decidedly the most successful treatment has been spraying the trees early in spring, when the young caterpillars are just hatched, and again two weeks later on with a weak solution of Paris-green."

Again, in another part of the same letter, Mr. Fletcher observed :—"With regard to the Winter Moths which have been so injurious in England this year, I am under the impression that the most satisfactory mode of treatment will be to spray or dust the trees with some of the preparations of arsenic. For my own part I prefer 'Paris-green,' as being of more uniform strength than 'London-purple' and other compounds. The chief point to be guarded against is getting the liquid too strong."

For liquid application, the amount recommended for spraying for Codlin Moth or young "looper" caterpillar is not more than from 2 to 4 ozs. in 40 (forty) gallons of water, or $\frac{1}{8}$ to $\frac{1}{4}$ oz. in a pail of water (4 gallons, E. A. O.), to be applied as a fine spray by means of a force-pump. The foliage must not be drenched, but the spray should only be allowed to fall upon the trees until it begins to drop from the leaves.

"For general use on mature foliage:—½ lb. of Paris-green, 50 gallons of water." First mix the Paris-green separately with a small quantity of water, then add to it the whole supply. All washes containing Paris-green must be constantly stirred to keep it in suspension, or it will sink to the bottom.*

At first here, as elsewhere, some difficulties in application of a new kind of treatment are likely to occur; if too strong, or the mixture not evenly distributed, the leafage *will be*, if too weak the caterpillar *will not be*, hurt; but the great point in first experiment is to be sure that the mixture is *not too strong*. If too weak, this mistake is easily corrected, and it would be best to try a pailful at first on a tree or two than to risk more. Also it is advised that it should be used in dry weather, or necessarily the application may be washed away; and likewise it is to be remembered that Paris-green is insoluble; it does not dissolve in water, but mixes with it, so unless the mixture is kept stirred, or by some means or other in movement, the powder will settle down at the bottom of the water.

The spray should be applied so as to reach all parts of the tree and both sides of the leaves, and should be sent so that it may coat the leaves as with a fine dew, not run down and drip. As soon as dripping begins spraying should cease.

It should not be done whilst the trees are in blossom, and warning is also given in the American works that sprayings should not be given in rapid succession. Several days, it is advised, should elapse between, unless of course, as may easily happen in difficulties of first experiments, the spray was manifestly so weak that the application counted for nothing. The effect of the Paris-green on the caterpillars does not always show directly, and it is undesirable to waste labour and material where the work is already done, and only requires a day or two to show it.

The following advice was kindly sent me for use in the experiments of our Evesham Fruit Conference, in addition to much other serviceable information which was placed in our hands by the Entomologist of the Dominion of Canada.

Mr. Fletcher wrote me on Feb. 28th, 1890:—

"Paris-green:—You are quite safe in recommending this; but insist upon these two things, *viz.*, 1st, to keep the mixture (which is a mixture, not a solution) well stirred all the time, and have the barrel well washed out after it has been filled ten or twelve times. The Paris-green is very heavy, and will keep sinking to the bottom unless constantly agitated, and as the barrel is frequently re-filled the residue will keep accumu-

* 'Report of Entomologist, Central Experimental Farm, Department of Agriculture, Canada,' 1887, p. 21.

lating, until it will be too strong as the mixture reaches the bottom. 2ndly, the other point is to insist upon the mixture not being made too strong; 1 lb. to 200 gallons I find very useful, and I never use stronger than 1lb. to 120 gallons."

For distribution of the spray engines or pumps fitted with what are known as "cyclone nozzles," and especially the form known as the "Riley cyclone nozzle," are considered to be the best. We have been much held back in our experiments by difficulty and delay in getting the most desirable kind of apparatus, but so far this has been satisfactory, that work has been successfully carried on with ordinary engines. Therefore, there is no drawback on this head in adoption of the application by all who have not convenience or desire to procure the more elaborate apparatus; but when the implement known as the Strawsonizer is issued, which can deliver dry or fluid dressings, as the lightest possible film or dew on every part of the tree and beneath or above the leaves, this may be expected to be of great service as a broad-scale distributor.

With regard to the nature of Paris-green.—"Paris-green" is an aceto-arsenite of copper, and of a poisonous nature, and therefore should be used with care in mixing, and should not be applied *to fruit*, or *to vegetables that are used for food;* but, as will be seen in the directions for use, the quantity advised for orchard-use in the Canadian Government Report, to check looper-attack on leafage, is very small; and our English experience of this year has shown that it can be as safely used here (with proper care) as it has now been used for regular farm and orchard work for many years, over an area of many thousands of miles, in the Continent of America.

On application to Messrs. Blundell & Spence, of Hull, as being well-known manufacturers and great exporters of Paris-green, Mr. J. Dixon (Manager) wrote me on December 31st, 1889:—"Emerald-green, Paris-green, Schweinfurth-green, are different names for the same thing. The first name is English, and is the one used in most of our Colonies, India, and China; the second is the American term; the third only used in Germany, and by German traders.

"Emerald- or Paris-green is a double salt of arsenite and acetate of copper—in other words, an aceto-arsenite of copper. You may take the U.S.A. analysis of Paris-green as correct.

"The pure article (which is that used as an insecticide) is a true crystal, and varies in colour from a deep to a pale green, according to the size of the crystals."

Mr. Dixon also favoured me with the following percentage analysis of pure Emerald-green:—

"Percentage Composition of Emerald-green:—

	Per cent.
"Copper . . .	32.11
Arsenic . . .	28.56
Oxygen . . .	32.48
Hydrogen . . .	0.76
Carbon . . .	6.09
Total .	100.00"

Cautions to be observed in the use of Paris-green.—The bags should be labelled Poison and kept locked up, and especially kept safely out of the way of children, who might be attracted by the beautiful colour.

Workers with the powder should not allow it to settle in any sore or crack in the skin of the hands, nor stir it about unnecessarily with the hands; and they should be *very careful not to breathe in the powder* through mouth or nose whilst measuring or mixing it.

For this reason it is most desirable that purchasers of Paris-green should have it sent *not* in bulk, to be divided for use on receipt, but wrapped in single pound (or small) packages by the senders. I particularly wish to draw attention to Mr. Dixon's observations on this head, given in his replies to my enquiries:—

"In handling this article in the dry powder, care is required, as a light green dust arises, which is breathed in, and produces unpleasant results; and in one instance a customer who thought he could save money by buying it from us in bulk, putting it up himself in paper parcels, employed a man to weigh out and wrap about 5 cwt. in 1 lb. parcels. *This cost the man his life;* so as we are laid out for this business, sometimes wrapping 10 tons in a week, we can really do it at much less cost.

"We have never heard of any accidents to users in America, and there is no danger when using it in water" (*i. e.*, from its flying about, E. A. O.); "but you might advise any who wish to try dusting it on dry to carefully stand to windward."—(E. Dixon (Director), Messrs. Blundell & Spence, Hull.)

Messrs. Blundell & Spence, will now, if wished, send out small orders damped, which saves all risk or danger from powder flying about.

Sheep or other animals should not be pastured or allowed to feed beneath trees that are being sprayed, or have recently been sprayed with the "green."

In fact, ordinary care and caution should be exercised; like many other poisonous mixtures this may be used without the slightest danger or damage, *if* reasonable care is used; if not,

there is quite a possibility of disagreeable effects or dangerous illness ensuing, or *possibly* death.

The cost of the Paris-green is very little. The firm with whom I have corresponded on the subject inform me that as wholesale manufacturers they could furnish quantities of 1 cwt., and over, at the rate of 10*d.* per lb. Retail traders would probably not furnish the pure article under 1*s.* 3*d.* per lb.

The above observations refer mainly to the instructions as to method of use of Paris-green for spraying purposes, given in the Government Reports of Canada and the United States, and details of the nature of the application. In the following notes I give, as shortly as I can, an account of the careful public trial (extending over a period of about three months) which has been made by the members of the Evesham Fruit-growers' Conference, in the spring and early summer of this year, as to the serviceableness of this treatment for destroying orchard caterpillars, without injuring the infested leafage, in the somewhat different climate of this country; and the results, which where the instructions were followed were reported as very successful; in some other cases the leafage suffered, this owing, as far as appears, to instructions in some instances not being followed, also very especially to want of the proper apparatus for throwing the spray (a difficulty which can be remedied), and also apparently in some instances from hot, burning sunshine occurring soon after treatment, a difficulty less easy to meet the chance of.

For some years back trials have been made, in many isolated cases, of various kinds of treatment which it was hoped *might* lessen the hordes of caterpillars which now yearly cause great injury to orchard leafage; but as these experiments were seldom carefully recorded as to details or results, they have been of little public benefit.

It therefore seemed desirable to form a regular Experimental Committee, of members cognisant of all the needs of the case, and also *known to be qualified*, both practically and scientifically, to superintend experiments in orchard treatment, and report results.

Accordingly, about the end of February this year (1890), at a conference of fruit-growers held at Evesham, a Committee of Experiment was formed, of gentlemen personally interested in the subject, as land-owners or fruit-growers on a large scale, or superintendents of large fruit-grounds, or in other ways much concerned in the preservation of orchard-crops.*

* The Committee consisted of Mr. Gibbon, of Seaford Grange, Pershore (who has given valuable aid to the Committee as Chairman); Mr. J. Masters, of Evesham, Hon. Sec.; Capt. Corbett; and Mr. C. D. Wise (respectively Superintendent and Deputy-Superintendent at the great Toddington Fruit-grounds);

The plan of operation was for the members to try the effect of any kind of sprays, washes, or other applications, which they might judge likely to be effective in destroying the caterpillars on orchard trees without injuring the leafage; and to meet at various different centres from time to time, so that the whole Committee could judge of results of various treatments, and consultation and detailed reports of the method of treatment take place, or be given by the members.

This plan has been thoroughly carried out, and amongst the special consultations may be mentioned the meeting at the Toddington Fruit-grounds on the 1st of May; also at Seaford Grange, the residence of the Chairman of the Committee, on the 14th of the same month; and on the 11th of June, to inspect the plantations of Messrs. Masters & Groves at Greenhill.

I have myself, through the courtesy of Mr. J. Masters, Hon. Sec. of the Committee, and Mr. C. D. Wise, the able Deputy-Superintendent of the Toddington Fruit-grounds, been in communication and receipt of information of progress throughout, and from this, as well as from the published reports of the Committee, can state that the experiments have confirmed the statements of which we were in possession of the beneficial effects of Paris-green, when applied according to direction, in destroying the caterpillars without injuring the leafage; although in some instances, from causes which appear for the most part avoidable (of which I give a note further on), damage was observable to leafage in some places towards the end of June, after the occurrence of some days of very hot weather.

Many other applications were tried, and to some degree there was at least partial success with an arsenical compound called London-purple; but the following few quotations from recommendations of the Committee, and reports to myself to lay before the Royal Agricultural Society, or for publication, are as much as space here now allows.

On May 1st the following conclusions were unanimously agreed to by the Committee:—

"That for spraying Plum trees Paris-green paste, in the proportion of one ounce to eight or ten gallons of water, is effective in destroying the caterpillar, and at the same time is not injurious to the foliage of the trees. For Apple trees,

Mr. Swift, a large land-owner and occupier of land in the neighbourhood; Mr. Doeg, of Evesham; and Mr. Hiam, of Ashwood Bank; likewise Mr. F. Hooper and Mr. E. Grove. I rendered what assistance lay in my power as the Consulting Entomologist of the Committee, and we were greatly favoured by being allowed in all difficulties to apply for advice to Mr. J. Fletcher, the Entomologist of the Dominion of Canada; and thus knew that so far as we followed instructions we were trying no new thing, but what had been known to answer in Canada and America for regular orchard service for years back.

however, one ounce to twenty gallons of water is sufficient. London-purple in the proportion of one part to twenty parts of water was considered by the Committee to be destructive to the caterpillar, and while slightly scorching the foliage did not materially injure it."

By the time of the next meeting the benefit of the treatment was so obvious that applications were coming in from gardeners of the neighbourhood to the Committee, for information how they also could save their trees.

On application to Mr. C. D. Wise, Deputy-Superintendent at the Fruit-grounds at Toddington, for a short note as to progress,—in order that I might report results of our work up to date,—on the 3rd of June, at the meeting of the Seeds and Plants Disease Committee of the Royal Agricultural Society, he favoured me with the following reply:—

"We have as you know tried all sorts of mixtures, and I don't think it is worth while troubling you with all particulars of them, as they were all useless or nearly so. Paris-green is the only thing which we have found really efficacious. For Plums the proportion is 1 oz. to 10 gallons, and for Apples 1 oz. to 20 gallons. We have also used the former strength for Currants, but as the foliage is within the last few days becoming so much stronger, we have been using it at 1 oz. to 8 gallons. Neither of these solutions has damaged the foliage, but killed the caterpillar. . . . As regards the Riley nozzle, we have tried it and found it very similar to that on the French pumps; in fact, there is very little difference between the two, that is, in the way the liquid is distributed."

Mr. Masters, also, the Secretary of the Evesham Experimental Committee, replied, still continuing the previous information as to the efficacy of the Paris-green in destroying the caterpillar, and also considered there was confirmatory proof that the Paris-green might be used with perfect safety to foliage at a greater strength than that mentioned above.

I also requested information from Messrs. A. Salmon (Fruit-growers), near Hounslow, with whom I had been in communication relating to orchard use of Paris-green, in order to obtain a report of the effects of the application, on a regular scale of working business independent of our special experiments, with ordinary garden engines. Messrs. Salmon reported in reply, on the 31st May:—"All we can say about it is to its advantage. It has succeeded admirably. The trees look healthier and better, with as much (if not more) on, as anywhere else. They are beautifully clean. It has not injured them in the slightest degree. We shall always use it in case of blight."

The following note on the subject from Mr. John Riley, of Putley Court, Ledbury, also shows the serviceableness of the application, even without any note of the use of special spraying machines:—"We tried Paris-green, London-purple, and chrysoline, for the caterpillars. We began late, when the caterpillar was strong. Paris-green we found by far the best; it killed the caterpillar in a short time, and did not damage the foliage at all. It was used as recommended by your Committee."—(J. R.)

On the 20th of June Mr. Masters added a further satisfactory note, with the following information and useful hint regarding mixture of flour with the green:—

"When the foliage of trees is young and tender, I do not think it safe to apply the Paris-green stronger than in the proportion of 1 oz. to ten gallons of water. But when the foliage is matured, and the caterpillar is full grown, a solution of 1 oz. Paris-green to 6 gallons of water may be safely used; for every case it would be well to use about 2 lbs. of fine wheat flour to every pound of Paris-green; it thickens the solution, and prevents the particles of Paris-green from settling at the bottom of the vessel, and, when it is sprayed, helps to secrete the preparation on the foliage."

The point which, at the date of writing, appears to be the chief difficulty, is the risk of bright, hot sunshine occurring after spraying, and causing mischief to the leafage. On June 26th Mr. Masters wrote me that some of the trees syringed with Paris-green then showed injury to the leafage which had not been noticeable until the last few hot days. This appeared to be attributable to the action of the heat where the Paris-green mixture had been applied stronger than was recommended, or where the syringe used did not deliver it properly on the leafage, but so that it remained in excessive quantity.

It is of great importance not to exceed the proportions specified in the preceding instructions; also *not to spray frequently;* a fortnight should elapse between one application of spraying and a succeeding one, unless there are special circumstances pointing to some difference being allowable; and also to have a spraying apparatus which will deliver the spray as a fine general mist, not as a wash which will drop from the trees.

When the form of "Strawsonizer" especially arranged with a view to orchard use is issued, this may be expected to be of much service as a spraying implement. Meanwhile, as not only our own but other experiments were greatly held back at first for want both of proper apparatus and also want

of knowing where it was procurable in England, I add the following information, which was kindly sent me during July, by Capt. Corbett, from Toddington:—

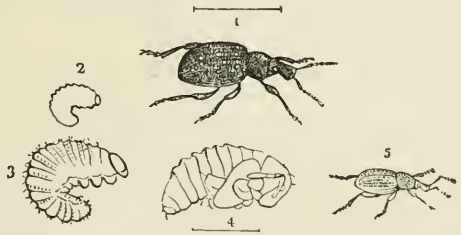
"The Knapsack Pump, or No. 1 'Eclair,' used at Toddington plantations, will be to be had of Messrs. Chas. Clark and Co., Windsor Chambers, Great St. Helen's, E.C., sole agents. One great advantage is, that the movement of the man keeps the liquid agitated. It is an admirable instrument, and we like it better than anything."—(R. J. C.)

All those who desire to study the instructions and information in detail regarding the methods of application of Paris-green, by which it is found to act trustworthily and *safely*, will find them in the publications noted below; and I have entered at such great length on the subject, as it is of vital importance to the fruit-growing industry to have some means at hand by which the caterpillar plague can be exterminated; and at present, excepting mineral oil and soft-soap wash,—which also has dangers to leafage—we do not know, either by published documents, or by our own experiments with most of the ordinary applications, of *anything* which answers as well elsewhere and gives *hope of doing so here*, when the management of it is properly gained, as Paris-green.

For many details regarding composition and method of use of Paris-green, see "Paris-green as an Insecticide," 'First Annual Report on Injurious and other Insects of the State of New York,' 1882, by Dr. J. A. Lintner, State Entomologist, pp. 25—34: Albany, U.S.A.; "Notes on Paris-green," pp. 8—16, in 'Seventh Annual Report of Noxious and other Insects of the State of Missouri,' 1875, by Prof. C. V. Riley, now Entomologist of Department of Agriculture, U.S.A.; "Paris-green," 'Fourth Report of United States Entomological Commission, U.S. Department of Agriculture,' 1885, pp. 143—148; and other reports quoted from in preceding paper.

RASPBERRY.

Black Vine Weevil. *Otiorhynchus sulcatus*, Fab.
Clay-coloured Weevil. *O. picipes*, Fab. (*septentrionis*, Steph. Man.)



O. picipes and *O. sulcatus*: 1—4, *O. sulcatus*, maggot and pupa, nat. size and magnified, or with lines showing nat. length; 5, *O. picipes*.

The two kinds of weevils — scientifically *Otiorhynchus sulcatus* and *O. picipes* of Fabricius—figured above have an enormous capacity for doing mischief. In beetle state they feed on leaves and shoots of various plants, amongst which Vines, Raspberries and Strawberries may especially be mentioned, though unfortunately the list might be much lengthened, and sometimes includes field root-crops, of which an especial instance came under my notice in 1885, when the two above-mentioned kinds greatly injured twelve acres of Mangolds.

On June 10th Mr. Warner wrote to me from the Nurseries, Leicester Abbey, regarding an attack of brown beetle-like insects, which appeared, as he said, to be "almost omnivorous," and, after giving a list of attacked plants, further noted, "*They are now materially injuring twelve acres of Mangel Wurzel.*" From the specimens accompanying these proved to be *Otiorhynchus sulcatus* and *O. picipes*.

I have also had twigs of Red Currant, Cob Nut, and Damson (as well as of Raspberry), sent with specimens of beetles accompanying, to show the "sad havoc" made in fruit plantation by the *Otiorhynchus picipes*: as many as 105 of the beetles were reported by the sender as having been found on the stem of one Cob Nut tree.

The two species mentioned above as well as the *O. tenebricosus*, or Red-legged Garden Weevil, are exceedingly hurtful by feeding on the shoots, leaves, and buds; sometimes also on the fruit and flower-buds; and in the larval state they are injurious by feeding on the roots.

The larvæ and pupæ of each of these three species of weevil are very similar to the others, and so are the remedies and means of prevention; therefore I place them under one heading.

The *O. sulcatus* takes its popular name from being especially injurious to Vines, and is also hurtful to Strawberries.

The *eggs* are laid a little below the surface of the earth. The maggots are legless, whitish, somewhat hairy, and are to be found from about August until the following spring at the roots of their food-plants.

The pupa, figured at p. 361, is yellowish white, with brownish hairs, and is to be found in April lying three or four inches below the surface, where it is stated to remain only fourteen days in this state before development.

The weevil is a little over four, and sometimes five, lines in length, is of a dull black, with a short snout or proboscis; the body between the head and abdomen is granulated, and the wing-cases are rough, with several raised lines and spotted with pale hairy tufts, and, like the other species of *Otiorhynchus*, it has *no wings*.

The *O. picipes*, or Clay-coloured Weevil, differs from the above in being smaller, and is reddish brown or testaceous, mottled with ashy scales, so that when only slightly magnified it looks of a mottled, dusty clay colour. This species is also very injurious to wall-fruit trees and Vines in hot-houses, and was identified in 1879 as being the species which caused great damage to Raspberry plants in Cornwall.

A third species—the *O. tenebricosus*, or Red-legged Weevil—is also mentioned by John Curtis, in the 'Gardeners' Chronicle' for 1842, p. 316, as being very hurtful to garden-fruit trees. The beetles feed on the buds, young shoots, bark, leaves, &c., of Apricots, Nectarines, Peaches, Plums, &c.; and have been found also, in the maggot state, doing much harm to the roots of Raspberries, Currants, Gooseberries, Strawberries, and to vegetables.

This weevil, when recently developed, has the wing-cases dotted over with spots of delicate yellow down; these soon rub off, when the beetle appears to be of a shining black; it is sometimes of a reddish pitchy colour, whilst still immature. The wing-cases are united to each other, and the legs are generally bright chestnut-colour.

The specimens which are most commonly sent me are the *O. sulcatus* and *O. picipes*, but in June, 1883, Prof. Allen Harker, of the Royal Agricultural College, Cirencester, forwarded specimens of *O. tenebricosus*, which were then doing much harm by eating leaves of the Strawberries in the garden of the College Farm.

The weevils were in such numbers that thirty of them were secured in a few minutes from their daytime shelter around the Strawberry roots. A female that was dissected contained eggs fully developed.

Prevention and Remedies.—The habit of the weevils of sheltering away from the light during the day is one great help towards keeping them in check. They feed by night. By day they hide away, either buried in earth by the walls against which their food-trees are trained, or underneath small clods round the stems of the trees on which they feed, or in rough bark; crevices where mortar has fallen out of old garden walls often swarm with them, and generally they shelter in any dark nook near at hand to their nightly resort.

Where the attack was bad enough to make it worth while to "sticky-band" the trees as for prevention of Winter Moth, this would be a good plan, as the weevils, being wingless, must travel on foot. But this plan would, of course, not be of service for bush fruits such as Raspberries, nor where the trees were fastened to walls.

In such cases (looking at the habits of the weevil of hiding during the day in any crannies, or under clods of earth, stones, or rubbish), it would be very desirable to keep fruit-walls well pointed; also that all clods of earth, &c., should be cleared away that might serve as lurking-places. As they especially go down close to the wall, it might answer to run a line of ashes sprinkled with dilute paraffin, or with carbolic acid diluted in the proportion of one part of acid to a hundred of water, just along the junction of wall and ground.

A band of any kind of rough, cheap, cart or axle grease, run along the lowest part of the wall, would isolate it from attack, if the trees were also properly sticky-banded.

In the case of attack on Strawberry plants, and on the larger scale of plantation fruit-growing, it would be easy to find what kind of shelter the weevils preferred; and by placing some of this, whether slates, tiles, odd bits of thin turf, or *morsels of old waste sacking*, on the ground by the stems of the young trees, these would probably form excellent traps, which might be cleared daily with little trouble.

The best method of *remedy* is based on the habit of the weevils of dropping down off the bushes on any disturbance when feeding at night, or if a light is flashed on them.

In 1878 the Raspberry plots in the large fruit-gardens in Gulval and part of Madron, in Cornwall, were injured by weevil attack, the loss being estimated at many hundreds of pounds. On two acres of Raspberry-ground at Gulval the loss of crop from injury to the canes was estimated at one

hundred pounds, and specimens forwarded from this ground in 1879 were identified as *O. picipes*.

These weevils fed on the bushes by night, and towards dawn went down and hid themselves beneath the surface of the earth, or under stones, &c. As all the remedies tried had proved useless, a number of wooden trays were constructed, the inside of which was smeared all over with tar; and after dark one man held a tray beneath an arch (arch-training being the plan used); another, whilst carrying a lantern, gave the bush a smart tap, and the weevils fell into the tray; the tar held them prisoners for a time, and after the tray had been placed under a bush or two the weevils collected were killed by pouring boiling water upon them. Thirty or forty persons were thus employed, and each bush was thus treated three times. An immense number of weevils were caught, estimated at hundreds of thousands, and it was hoped, by continuing this plan, to avoid much future loss.—(J. T.)

On a small extent of ground the use of a common sweeping-net has been found to answer for clearing bushes after dark.

The commonly-adopted method of destroying these weevils in vineries and peach-houses is to spread cloths below the boughs, and shake the beetles down on them at night; then gather the beetles together and destroy them with boiling water. This plan is equally applicable to standards, and, with a little management, to wall-fruit trees; but it should be borne in mind that, as they drop when frightened, operations must not be begun until the cloths are placed ready.

It is recommended by Mr. Malcolm Dunn, of Dalkeith, that a white sheet should be laid under the boughs the day before, and a large and bright light used, so that when the beetles fall they may be easily noticed; otherwise, if no sheet has been spread and the light is dim, many of the beetles are almost certain to escape, from their colour being so like that of the ground.

Another method is for two people to hold a sheet below the boughs, and for a third to shake and then bring a light to catch the beetles by; but the above-mentioned plan is better.

Getting rid of the maggots is a most difficult task, but it was found by Mr. Malcolm Dunn that watering with a "strong solution of ammoniacal liquor and common agricultural salt is effective in preventing the increase of this pest."

Where the ground was empty, a scourging dressing of fresh gas-lime would probably clear the pests; but commonly they lie by their food-plants which would be killed by such treatment.

Skimming off the uppermost four inches of soil for about a foot, in front of the walls on which the trees were infested,

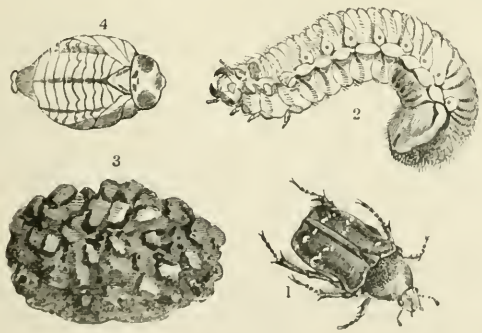
would be worth trying as an experiment, to be carried out further if many maggots were found; by throwing some of the removed earth into a large tub of water it would be seen directly whether there were either maggots or beetles present.

Small plants may have their roots washed out, and thus be saved; but the ground on which they grow should be thoroughly dealt with at once. A good handful of fresh gas-lime put into each hole at once is a good cure for what evil may remain.

These pests should be looked to on their very first appearance, for they are most difficult to get rid of, and, as in many other cases, even severe cold has little effect on the maggots. From experiments in my own garden I found they would stand a temperature as low as 11·8°, that is, just over twenty degrees of frost, without being (as far as could be seen) in the least injured.

STRAWBERRY.

Green Rose Chafer. *Cetonia aurata*, Linn.



Larva; back of pupa; cocoon; and beetle.

This chafer is injurious both in the larval and perfect state. In the first—that is, as a grub—it feeds on the roots of Strawberries, Grass, and other plants; as a beetle it frequents many kinds of flowers, including the Rose, from which it takes one of its names; but is more especially injurious by its attacks on Strawberry blossom, and to the flowers of Turnips left for seed, where it eats off the anthers from the stamens and thus renders the flowers abortive.

The eggs are laid in the ground, where the maggots hatch and feed for two or three years. When full-grown they are upwards of an inch and a half in length, thick and fleshy, of a whitish colour, with an ochreous head armed with strong jaws; the pairs of short feet are of a rusty ochreous colour, and the hinder portion of the grub or maggot is enlarged, curved towards the head, and of a lead-colour. These grubs are much like those of the Cockchafer, but, amongst other points, are distinguished by having a horny rusty spot on each side of the segment behind the head.

When full-fed they make earth-cases "as large as a walnut," at a considerable depth beneath the surface, which are smooth inside, but covered outside with pellets of soil which have passed through their own bodies; and in these cocoons they turn to ochre-coloured pupæ. The figure shows the appearance of the *back* of one of these, the legs and wings being folded beneath.

The Chafers, which sometimes appear as early as the beginning of May, are of the shape and size figured, of a rich metallic golden green above, with white or ochreous spots or streaks looking like cracks running across the bright green of the wing-cases; beneath they are coppery, with a rose-coloured tint. The horns are much like those of the Cockchafer, excepting that the club is formed of only three leaves (see fig. of horns of Cockchafer, p. 229).

Beneath the wing-cases are large brown membranous wings, by means of which when they have finished whatever is eatable in one place they can fly with ease to another; it may be a Strawberry bed, or may be a field of Turnips in blossom; and thus, if the weather is fine, they continue to attack whatever may attract them throughout the summer; in wet weather they die earlier in the season.—(John Curtis in 'Gard. Chron.' for 1841, &c.)

Prevention and Remedies.—The beetles are so large and so sluggish in dull weather that there is then no difficulty in taking them by hand; during sunshine they may be taken with a bag-net, and destroyed in any way that may be most convenient.

Where the maggots are numerous, they should be got rid of by turning over the soil, or by spreading neglected heaps of rich earth, old cucumber-beds, and similar places which they frequent, and hand-picking all that are seen. Poultry will help very much in clearing the grubs, if driven in whilst the ground is being turned over.

Where the attack is on the roots of growing plants, it will be found serviceable to have a few tame Rooks or Sea Gulls

in the garden, as they can dig down with their bills amongst the roots which could not otherwise be meddled with, and clear large numbers of the grubs without harming the plants.

The Rose Chafer when about to deposit her eggs will sweep round on the wing until she sees a suitable spot, and—hardly pausing from her flight—will disappear at once down any crack that may be open in the ground, or into a nook amongst boards, or otherwise; and the grubs may be found in the decayed wood-soil that accumulates within old hollow trees. It is therefore desirable to remove all wood-rubbish, and also heaps of decaying sawdust that may attract the beetle or shelter the grubs.

For other remedies, see " Cockchafer," p. 229.

For notes on *Otiorhynchus* (weevil) attack to Strawberry plants, and regarding *Julus pulchellus* (the Spotted Millepede), which is excessively injurious to Strawberry fruit, see references in Index.

LIST OF INSECTS

OF WHICH OBSERVATIONS ARE GIVEN IN THE FOREGOING PAGES; ARRANGED ALPHABETICALLY UNDER THE NAMES OF THE ORDERS TO WHICH THEY BELONG.

TO WHICH IS APPENDED A LIST OF A FEW OTHER KINDS OF CROP PESTS; ALSO WITH NAME OF ORDER OR FAMILY.

COLEOPTERA.—Beetles.

Anthonomus pomorum. Apple-blossom Weevil.
Apion apricans. Purple Clover Weevil.
A. assimile. Clover Weevil.
Balaninus nucum. Nut Weevil.
Bruchus rufimanus. Bean-seed Beetle.
Cetonia aurata. Green Rose Chafer.
Ceutorhynchus sulcicollis. Cabbage and Turnip-Gall Weevil.
Crioceris asparagi. Asparagus Beetle; Cross-bearer.
Doryphora decemlineata. Colorado Beetle.
Elater (*Agriotes*) *lineatus.* Striped Click Beetle.
E. (*Agriotes*) *obscurus.* Dusky Click Beetle.
E. (*Agriotes*) *sputator.* Pasture Click Beetle.
E. (*Athous*) *ruficaudis.* Red-tailed Click Beetle.
Haltica (*Chætocnema*) *concinna.* Tooth-legged Flea Beetle.
H. (*Phyllotreta*) *nemorum.* Turnip Flea Beetle.
Hylesinus fraxini. Ash-bark Beetle.
Hylurgus piniperda. Pine Beetle.
Meligethes æneus. Turnip-blossom Beetle.
Melolontha vulgaris. Common Cockchafer.
Otiorhynchus picipes. Clay-coloured Weevil.
O. sulcatus. Black Vine Weevil.
O. tenebricosus. Red-legged Garden Weevil.
Phædon betulæ. Mustard Beetle; Black Jack.
Phratora vitellinæ. Willow Beetle.
Scolytus destructor. Elm-bark Beetle.
Silpha opaca. Beet-carrion Beetle.
Sitones lineatus (and other species). Pea and Clover Weevils.
Xyleborus dispar. Shot-borer Beetle.

THYSANOPTERA.—Thrips.

Thrips cerealium. Corn Thrips.

HYMENOPTERA.

Bees, Wasps, Ants, Sawflies, Ichneumon Flies, &c.

Athalia spinarum. Turnip Sawfly.
Cephus pygmæus. Corn Sawfly.
Cynips kollari. Marble-Gall Fly.
Lophyrus pini. Pine Sawfly.
L. rufus. Fox Pine Sawfly.
Nematus ribesii. Gooseberry and Currant Sawfly.
Neuroterus lenticularis. Common Spangle-Gall Fly.
Sirex gigas. Giant Sirex; Wood Wasp.
S. juvencus. Steel Blue Sirex.
Tenthredo (*Selandria*) *cerasi.* Slug-worm; Pear and Cherry Sawfly.

LEPIDOPTERA.—Butterflies and Moths.

Abraxas grossulariata. Magpie Moth.
Acherontia atropos. Death's Head Moth.
Agrotis exclamationis. Heart and Dart Moth.
A. segetum. Dart, or Turnip Moth.
Anisopteryx æscularia. March Moth.
Bombyx (*Clisiocampa*) *neustria.* Lackey Moth.
Carpocapsa pomonella. Codlin Moth.
Charæas graminis. Antler Moth.
Cheimatobia brumata. Winter Moth.
Cossus ligniperda. Goat Moth.
Depressaria cicutella. Common Flat-body Moth.
D. daucella. Carrot-blossom Moth.
D. depressella. Purple Carrot-seed Moth.
Diloba cæruleocephala. Figure-of-8-Moth.
Grapholitha pisana. Pea Moth.
Hepialus humuli. Otter Moth.
Hybernia defoliaria. Mottled Umber Moth.
Hyponomeuta padella. Small Ermine Moth.
Mamestra brassicæ. Cabbage Moth.
Noctua (*Tryphæna*) *pronuba.* Great Yellow Underwing.
Orgyia antiqua. Common Vapourer Moth.
Pieris brassicæ. Large White Cabbage Butterfly.
P. napi. Green-veined White Butterfly.
P. rapæ. Small White Cabbage Butterfly.
Plusia gamma. Silver Y-moth.
Plutella cruciferarum. Diamond-back Moth.
Pygæra bucephala. Buff-tip Moth.
Pyralis rostralis. Hop-vine Snout Moth.
Retinia buoliana. Pine-shoot Tortrix Moth.
R. turionana = *Orthotænia turionana.* Pine-bud Tortrix Moth.
Tortrix viridana. Oak Leaf-roller Moth.
Zeuzera æsculi. Wood Leopard Moth.

HOMOPTERA.*—Aphides, Scale Insects, &c.

Aphis brassicæ. Cabbage Aphis, or Green Fly.
A. (Siphonophora) granaria. Corn Aphis; Dolphin.
A. (Phorodon) humuli. Hop Aphis.
A. mali. Apple Aphis.
A. pruni. Plum Aphis.
A. rapæ (Rhopalosiphum dianthi). Turnip Green Fly.
A. rumicis. Collier; Bean Aphis.
Aleyrodes proletella. Snowy Fly.
Chermes abietis. Spruce-Gall Chermes.
C. laricis. Larch Aphis.
Euacanthus interruptus. Hop Cuckoo Fly.
Eupteryx solani. Potato Frog Fly.
Mytilaspis pomorum. Apple Mussel Scale.
Pulvinaria ribesiæ. White Woolly Currant Scale.
Schizoneura lanigera. American-Blight Aphis.

DIPTERA.—Two-winged Flies.

Anthomyia (Chortophila) betæ. Mangold Fly.
Anthomyia brassicæ. Cabbage Fly.
A. ceparum. Onion Fly.
A. floralis. Radish Fly.
A. platura. Shallot Fly.
A. radicum. Root Fly.
Cecidomyia destructor. Hessian Fly.
C. tritici. Wheat Midge.
Chlorops tæniopus. Gout Fly; Ribbon-footed Corn Fly.
Dilophus vulgaris. Fever Fly.
Hylemyia coarctata. Wheat-bulb Fly.
Oscinis frit. Frit Fly.
Phorbia cepetorum = A. ceparum. Onion Fly.
Psila rosæ. Carrot Fly; "Rust."
Tipula oleracea. Daddy Longlegs; Crane Fly.
Tephritis onopordinis. Celery and Parsnip Fly.

Besides the accounts given of the insects noted above, mention is also made of the following:—

Tylenchus devastatrix, or "Stem Eelworm," and *Tylenchus tritici*, or "Wheat-Gall Eelworm," which belong to the family of the *Anguillulidæ* of the *Nematodes*, or "Thread-worms."

Julidæ, or "Snake Millepedes," of various species, and *Polydesmus*

* For observation regarding *Homoptera = Hemiptera-Homoptera*, see note, in list of Orders following.

complanatus, or "Flattened Millepede," belonging to the Order of Myriapods.

Tetranychus telarius, or "Red Spider"; *Phytoptus* (? sp.), or "Birch-Gall Mite"; and *Phytoptus ribis*, or "Black Currant-Gall Mite"; of which the first belongs to the section of the *Tetranychidæ*, or "Spinning Mites," the two others to the subfamily *Phytoptidæ* of the Order *Acarina*, or Mites.

And also, *Arion ater*, or "Black Slug," and *Limax terrestris*, the "Field or Milky Slug," belonging to the family *Limacidæ* of the great division *Mollusca*.

APPENDIX.

INTRODUCTION TO ENTOMOLOGY.

WITH

LIST OF ORDERS OF INSECTS.

In the foregoing observations on Insect Attacks, references are given to many standard works, in some of which the student will find full histories of the insects referred to, and in others will be able to find full information regarding method of Classification of Insects generally; or again, if he desires to study any special order in detail, he will find references to standard monographs on these subjects.

But for general working purposes it may be convenient to have a short account at hand of such of the main points of distinction between the different Orders of Insects, as will enable the observer of a crop attack to tell at least what kind of insect is before him, and also, what is of great importance agriculturally, how to distinguish generally between the different kinds of *larvæ* which are commonly most injurious to our crops, so that he may be able to tell whether the crop pest under consideration is a fly-maggot, a beetle-grub, a moth-caterpillar, or possibly not an insect at all.

In the following pages I have, therefore, endeavoured to give (in the list of the Orders of Insects, following the description of methods of insect life) notes of the most observable of the characteristic points by which the insects composing these different Orders may be distinguished from each other in their early as well as complete state. But in the small space available it is only the broad general distinctions, such as most commonly are noticeable, that it is possible to enter on, and the reader is especially requested to observe that this Introduction is only intended as a guide to the main points desirable for notice in practical study of British injurious insect attacks.

For those who wish to study the subject in detail, I know of no work superior to that on 'Classification of Insects,' by

Prof. J. O. Westwood, Life-President of our English Entomological Society, to whose works and to whose almost life-long friendly communication I gratefully ascribe the foundation of most of such technical Entomological knowledge as I may possess, and who has been well described by his distinguished fellow-worker, the Entomologist of the department of Agriculture of the United States of America, as the Prince of Entomologists.

In the lists of Orders I have endeavoured, by adding many figures, to convey the information more clearly than could be done by words; and for explanation of the special Entomological terms, which it has been impossible to avoid use of, the reader is referred to the Glossary appended to this Introduction.

Introduction.—Insects begin their lives either by being hatched from eggs, or produced alive by the female; commonly they are hatched in the form known as maggots, caterpillars, or grubs, but they are never generated by decaying vegetables, putrid water, bones, carcases, dung, or any other matter, dead or alive, excepting their own insect forerunners. They come out of these matters constantly, but, if the observer will watch, he may often see the arrival of the insects, the laying of the eggs, and be able to satisfy himself as to the gradual development and the method of breeding, and that the progeny is produced by the female insect.

The eggs are usually laid soon after the pairing of the male and female, and are deposited on or near whatever may be the food of the larvæ. They are laid singly or in patches, and are sometimes attached by a gummy secretion to the leaf or whatever they are laid on; occasionally they are fastened by a short thread, or raised (like the heads of pins) on a stiff footstalk of hardened viscid matter. Such insects as insert their eggs in living animal or vegetable matter are furnished with a special egg-laying apparatus or *ovipositor*, such as a borer, or organs enclosing bristle-like points or saws, by means of which the female pierces a hole, and passes the egg down into the wounded spot.

For the most part insect-eggs hatch shortly after they are laid, but sometimes they remain unhatched during the winter; and it is believed that, where circumstances are unfavourable to development, they may remain unhatched for years, but this point is one of those subjects on which more information is needed. They have been found to endure intense cold without injury, and, besides some special and extraordinary instances, it has been found by experiment that insect-eggs may be exposed to a temperature lower than that to which they are usually subjected in this country, and cold enough to solidify their contents without destroying their powers of hatching.

In a very few cases insects are partly developed before birth, otherwise, after hatching from the egg, or being produced alive (in the same first stage of development) by the female, insects pass their lives in three different conditions or stages successively.

The first is that in which they are known as maggots, grubs, or caterpilllars; in the case of Grasshoppers, Cockroaches and some other insects, *where the young are very much the same shape as the parent, only without wings*, they usually go by the parent's name; the young of Green Fly are sometimes known as "lice." In this state they are active, voracious, and increase in size; and in this first stage all insects are scientifically termed *larvæ*.

In the second stage some Orders of insects are usually inactive and cannot feed, as is the case with the chrysalis of the Butterfly, or the mummy-like form of the Beetle or Wasp with its limbs in distinct sheaths folded down beneath it; some, however, are active and feed, as Grasshoppers, Cockroaches, Aphides (or Green Fly) and others, and resemble the parent insect, excepting that their wings and, for the most part, their wing-cases are not as yet fully formed; and in this second stage all insects are scientifically termed *pupæ*.

The third state is that of the perfect insect, in which (whether male or female, or of whatever different kind, as Moth, Beetle, Cricket, Aphis, &c.) it is scientifically termed an *imago*.

The term *Larva* is from the Latin, meaning a mask or ghost, and signifies that the insect in this stage gives a mere vague idea of its perfect form.

Pupa signifies an infant, and is fairly appropriate to the second stage in which the insect is *forming* into the perfect state, but is not fully developed either in its limbs or functions.

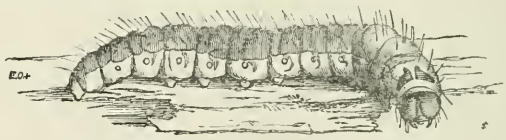
Imago signifies the image, the likeness, or an example of the perfect insect. The appropriateness of the scientific names for the first and third stage does not seem very clear, but there is no doubt of the convenience of having some *one term* by which each different stage of life of any insect may be described; and these are the words that have been adopted; in the following pages some detail is given of these three successive stages of development.

Larva (Maggot, Grub, Caterpillar, &c.).—If an insect-egg about to hatch is held against the light, or examined as a transparent object by means of a strong magnifier, it will be seen that there is a speck inside which increases in size and becomes more regular in shape daily, until it is too large for the egg to contain, when it breaks through this thin film

which serves as an egg-shell, and often begins life by eating it. This is the larva. It is usually hatched from an egg, but sometimes is produced alive (as some fly-maggots, or Aphides during the summer months). When it is coloured and has many feet, it is usually called a caterpillar; white fleshy larvæ, such as those of many Beetles or Flies, are commonly known as grubs or maggots; such as resemble the parent insect are usually known by the name of this insect; but the term of "worm" or "slug" is objectionable, as it leads to confusion.

Eggs (mag.) of Turnip-blossom Beetle.

Larvæ differ very much in appearance: some are legless, cylindrical, or blunt at the tail, and tapering at the head end, with the head (which is soft and furnished with hooks by way of feeding apparatus) capable of being drawn some way back into the maggot; many Fly-maggots are of this kind. Some larvæ are legless or with the mere rudiments of a pair of legs on each of the three rings behind the head, fleshy, smallest at the tail, and furnished with distinct head and jaws; such are some kinds of Beetle- and Wasp-grubs; others are strong and fat, a few inches in length, with three pairs of legs well developed—as the Cockchafer grub.*



Caterpillar of Goat Moth.

The caterpillars of the Butterflies and Moths are often beautifully marked, and have for the most part a pair of articulated feet on each of the three segments behind the head, and pairs of fleshy appendages called sucker-feet on some of the other segments and at the end of the tail, not exceeding sixteen in all. These "sucker-feet" enable the caterpillars to hold firmly to the twigs they frequent. Proceeding onwards still by number of feet, the caterpillars of the Sawflies will be found in almost every case (Corn Sawfly, *C. pygmæus*, excepted) to have, besides the three pairs of true feet, five, six, or seven pairs of sucker-feet, and also the pair at the end of the tail (known as the caudal pro-leg).

* For examples of different forms of *larvæ* and *pupæ*, the student is recommended to examine the figures of insects in their various stages given in the preceding pages, and also in the following illustrated notes of the main distinctions between the different Orders of Insects.

Sometimes, as with Grasshoppers, Locust, Aphides or Green Fly, Plant Bugs, &c., the young in the first stage—whether produced alive or hatched from the egg—much resembles the parent, that is, has a distinct insect shape, of head with horns, trunk or *thorax*, furnished with six legs, and abdomen; and differs mainly in size and in being wingless; *but, whether in this shape, or what is known as grub, maggot, or caterpillar, or whatever kind of insect it may belong to in this first stage, it is scientifically* A LARVA.

Larva of Locust.

In this larval stage the insect feeds voraciously and often grows fast: the skin does not expand beyond certain limits, and when this point is arrived at, the larva ceases feeding for a while; the skin loosens, cracks, and is cast off by the creature inside, which comes out in a fresh coat, sometimes like the previous one, sometimes of a different colour or differently marked. This operation is known as *moulting*, and occurs from time to time till the larva has reached its full growth. The duration of life in the first or larval state is various; in some instances it only extends over a week or two; in some (as with the Wireworm and caterpillar of the Goat Moth) it lasts for a period of three, four, or five years.

As far as observations go at present—that is to say, with such kinds as have at present been observed—larvæ are not injured by an amount of cold much beyond what they are commonly called on to bear in this country; but they are liable to injury from over supply of moisture, whether from sudden rain in warm weather or from full flow of sap of their food-plant, and in this point of their constitutions we have a principle that may help much towards getting rid of them.

When the larva has reached its full growth it ceases feeding, and (in the forms known as caterpillar, grub, or maggot) it usually either goes down into the ground and forms a cell in the earth, or spins a "cocoon" (that is, a web) round itself of threads drawn from the lower lip (as in the well-known Silkworm-cocoon), or in some way it makes or seeks a shelter in which it changes from the state of *larva* to that of *pupa*. These various changes are not mere matters of curious

enquiry, but can be used very serviceably, in prevention of recurrence of attack.

Pupa (Chrysalis).—It is much to be regretted that we have no generally-adopted word, excepting "chrysalis" (which is commonly used in the case of Butterflies or Moths), to describe the second stage of insect life in which it is changing from the state of *larva* to that of the complete insect.

Whilst in this condition it is for the most part without power of feeding and perfectly inactive, lying (as in the case of Beetles,—the common Cockchafer for instance,—Bees and Wasps, and some others) with the limbs in sheaths folded beneath the breast and body, or (as with Butterflies and Moths) protected by a hardened coating secreted from the pores of the creature within, when it casts its last larval skin. The method of this change may be easily observed in the case of the caterpillar of the Peacock Butterfly, which fastens itself by the tail, and then (after its black and silver-spotted skin has cracked) by infinite wriggling and struggling passes this cast-off skin backward, till it is pressed together

Larva and pupa of Cockchafer.

at the tip of the tail; and the creature from within appears in its new form as a bright green chrysalis, or *pupa*. It is covered with a moist gummy exudation, which quickly hardens and forms a protecting coat, and in due time (if left unharmed) the Butterfly inside would crack through this and appear from within the case; but if it is wished to observe that the beginning of the change to the Butterfly form has taken place already, one of these chrysalids may be dropped into a little warm turpentine, or turpentine and Canada balsam, directly the caterpillar-skin has been cast; this will soften the gummy coating just mentioned, and the limbs of the future Butterfly will be seen.

In some cases the change takes place (as with various but not all kinds of Flies) in the hardened skin of the maggot, which may be called a "Fly-case"; and in some (as with Plant Bugs, Aphides or Green Fly, Grasshoppers, and some others) this state of *pupa* is an active one, in which they move and feed, and resemble the perfect insect, excepting in having more or less rudimentary wings or wing-cases.

When the time for development has come, the pupa (if it is one of the active forms, as of a Grasshopper, for instance) may be seen looking heavy and stupid; presently the skin of the back splits lengthwise, and through the opening the perfect insect slowly makes its way out of the pupal skin, carefully drawing one limb after another from its precisely-fitting case, the long hind legs the last, till (in the instance observed, in twenty minutes) the perfect Grasshopper stands by the side of the film of its former self. Flies press out one end of the Fly-case, or crack it open, or leave the sheaths of the limbs and body behind, and Beetles and Wasps cast the film from their limbs; Butterflies and Moths crack open the chrysalis-case, and after a short time (during which the wings that had lain undeveloped are expanding) they appear of their full size. The insect is now fully formed; it will grow no more; its internal, as well as external, structure is complete; and it is what is known scientifically as the *imago*.

Imago (Beetle, Butterfly, Wasp, Fly, &c.).—This is defined as an animal formed of a series of thirteen rings or segments, breathing by means of tubes (tracheæ) which convey the air from pores in the sides throughout the system, and divided into three chief portions. Of these the first is the head, furnished with horns (antennæ), a mouth (differing very much in form in different kinds of insects), large compound eyes (which consist of many small ones formed into a convex mass on each side of the head), and frequently two or three simple eyes on the top.

The second portion (called the *thorax*, or sometimes the "trunk") is formed of three rings bearing a pair of legs attached to each, and having usually a pair of wings on the second and third of the rings; but sometimes the wings are wanting, sometimes there is only one pair.

The third portion (called the abdomen) is formed of the remaining nine rings, and contains the organs of reproduction and most of those of digestion.

Insects in this perfect state are of two sexes, male and female; in some instances (as with Wasps and some others) there are imperfectly-developed females, known as "neuters."

After the insect—whether Beetle, Butterfly, Fly, or other kind—has come from its chrysalis or Fly-case (that is, from the *pupa*), and its limbs have expanded, it is complete, and its remaining work is to support life until it has propagated its species. Usually *pairing* soon takes place, and the male dies; but the female has great tenacity of life until she has laid her eggs. The length of life, however, is various; in some instances a few days, or even hours, is the extent: in others the insects "hybernate," that is, find some shelter in

which they pass the winter, and from which they reappear with the return of warmth and sunshine.

Classification of Insects.—Opinions of different writers vary much as to the most desirable form, but the method appears to be the most simple and comprehensive in which they are divided into thirteen Orders, arranged according to general similarity in the early stages, and also in the general appearance of the perfect insects composing each Order; also according to the number or nature of their wings, or the method in which they are folded beneath the wing-cases.

In the following table the Orders are arranged accordingly in the classification given in Prof. Westwood's 'Introduction to Entomology,' these thirteen Orders being formed into two great tribes of *Mandibulata* and *Haustellata*, according to whether they feed by means of jaws (mandibles), as in the case of Beetles, &c., or by means of some kind of sucker (haustellum), as is the case with Butterflies, Aphides, &c.

These Orders are placed in succession according to the nearest resemblance which the insects of one Order bear to the one preceding or following; and the reader will notice that the two last syllables of the name of each order are *Ptera*, meaning "wings," from the Greek word *Pteron*, a wing. The preceding part of the word signifies the nature of the wing.

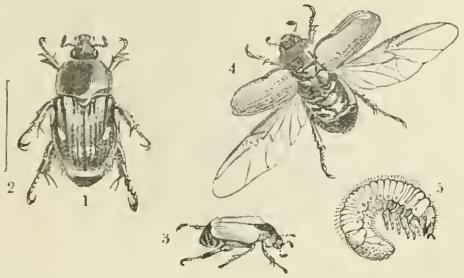
MANDIBULATA.

Coleoptera.—Sheath-winged. Beetles.
Euplexoptera.—Tightly-folded winged. Earwigs.
Orthoptera.—Straight-winged. Cockroaches, Crickets, Grasshoppers, &c.
Thysanoptera.—Fringe-winged. Thrips.
Neuroptera.—Nerve-winged. White Ants, May-flies, Dragon-flies, &c.
Trichoptera.—Hairy-winged. Caddice-flies.
Hymenoptera.—Membrane-winged. Saw-flies, Gall-flies, Ichneumon-flies, Ants, Wasps, Bees, &c.
Strepsiptera.—Twisted-winged. Bee-parasites.

HAUSTELLATA.

Lepidoptera.—Scale-winged. Butterflies, Moths.
Homoptera.—Similar-winged. Lanthorn-flies, Cuckoo-spit Flies, Aphides, Scale Insects, &c.
Heteroptera.—Dissimilar-winged. Plant-bugs, &c.
Aphaniptera.—Imperceptible-winged. Fleas.
Diptera.—Two-winged. Gnats, Daddy Longlegs, Gadflies, Bot-flies, Flesh-flies, &c.

1. COLEOPTERA (Aristotle).—Beetles.

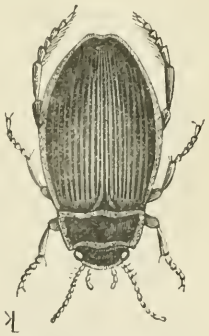


Field or Garden Chafers: 1 and 2, *Anisoplia agricola*, mag. and nat. length; 3, *A. horticola*, nat. size; 4 and 5, the same, and grub, mag.

The upper pair of wings, which are called wing-cases or *elytra*, are usually horny or leathery, and thus form a "sheath" for the large membranous under wings which are folded beneath them. The head is furnished with large eyes, jaws moving transversely, and with horns (*antennæ*) of very various shape.

In the Water Beetles the hinder legs are often flattened to a somewhat oar-like shape, and fringed with hairs.

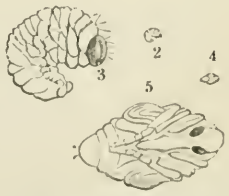
The larvæ are usually fleshy grubs having scaly heads furnished with jaws; sometimes they are legless, but commonly have a pair of short legs on each of the three segments next to the head; and the last segment of the body (or end of the tail) has often a fleshy foot beneath it.



Dytiscus marginalis, Water Beetle.

Wireworm, nat. size and mag.

The pupæ are inactive, of a whitish colour, and resemble the Beetle in shape; with the head bent forwards, and the legs and wings laid along beneath the breast and abdomen. For illustrations of various kinds of Beetles, see Cock-



Larva and chrysalis of Clover Weevil, nat. size and mag.

chafer; Ladybirds; Turnip "Fly," or Flea Beetle; Weevils of various species; and Wireworm Beetle.*

2. EUPLEXOPTERA (Westwood).—Earwigs.

Earwig, with wings spread, magnified.

The upper wings are *minute* and *leathery*, with the comparatively very large under wings (as the name implies), *tightly folded* beneath. The mouth is furnished with *jaws*, and the end of the tail with pincer-like appendages.

The larvæ and *pupæ* are *active*, and much resemble the perfect insects in shape, except that the larvæ are without wing-cases or wings, and the pupæ, although possessing wing-cases, have only rudimentary wings.

(This Order is sometimes known as *Dermaptera*, skin-winged.)

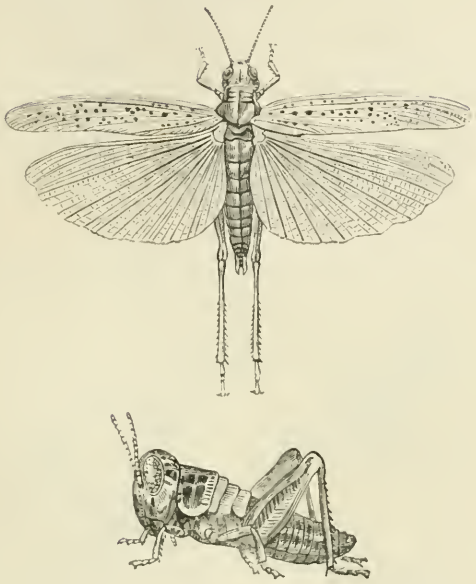
3. ORTHOPTERA (Olivier).
Cockroaches, Crickets, Grasshoppers, &c.

Upper wings *leathery* or *parchment-like*, very *thickly veined*. Under wings, which are folded lengthwise or "straight" beneath the upper pair, large, membranous, veined, with larger veins placed somewhat in a fan-shape. The under wings are absent in several species, and the upper wings in at least one.

Head generally large, upright, with the mouth at the lowest part, and rather backward. Mandibles strong; horns usually thread-like. Legs long and robust. Abdomen joined to the part of the body before it by its whole width, often

* The agricultural student will please observe that, although the grubs or larvæ of the beetles are so very variable in general shape, they may commonly be distinguished by the characteristics of having distinct scaly or horny heads furnished with jaws, and *no* sucker-feet, excepting sometimes one pair at the tail. They have often, but, as shown (p. 381), not always, one pair of claw-feet on each of the three segments next to the head.

prolonged at the tail, or furnished in the females with an ovipositor.



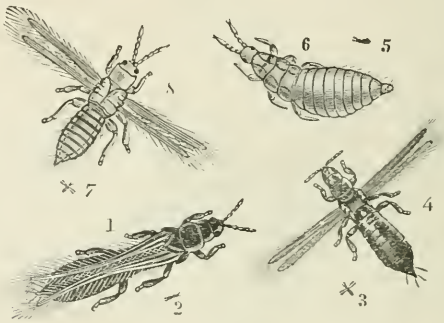
Locust, and larva, *Caloptenus spretus*.

Gryllotalpa vulgaris, Mole Cricket: 1, eggs; 2 and 3, larva, just hatched, and after first moult; 4, perfect insect.

The larvæ and *pupæ* are *active* and voracious, and are much like the perfect insect, excepting that the larvæ are wingless and the pupæ have "short rudimental wings and wing-covers which at the first period of this state are but slightly to be perceived."—(J. O. W.)

The Grasshopper is a good example of this Order. The Mole Cricket, figured above, is sometimes very injurious to plant-life by feeding on the roots, and is remarkable for the size and strength of its fore legs, but its upper wings are not characteristic of the *Orthoptera*.

4. THYSANOPTERA (Haliday).—Thrips.



1—4, Corn Thrips (female) at rest, and flying; 5—8, Potato Thrips, larva, and perfect insect flying; all nat. size and magnified.

The insects of this Order are often very *minute*, sometimes only about the third of a line in length. They have four wings which are *nearly alike* and usually long, narrow and with long "*fringes*" all round, laid flat along the back when at rest and somewhat curved outwards. The under side of the head is prolonged into a beak shape, with the parts of the mouth joined into a kind of sucker-like sheath, "out of whose free end the bristle-formed jaws project."

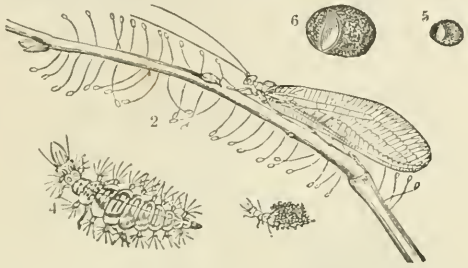
The larvæ and pupæ much resemble the perfect insect in shape, and in the first stage are active, in the second are sluggish. The male of the *T. physapus* (Kirby) is wingless.

The Corn and Potato Thrips are examples of this Order.

5. NEUROPTERA (Linnæus).
Dragon-flies, May-flies, Stone-flies, &c.

Wings four, nearly equal in size, membranaceous, with many "*nerves*" sometimes forming a network. The under

wings are occasionally folded. Head usually with jaws, but these are sometimes absent, as in the May-flies, which, only living for a short time, do not require apparatus for feeding with. Abdomen generally long and slender.



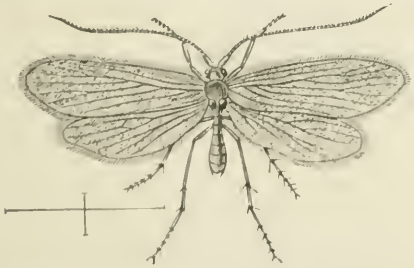
1, Golden-eye, *Chrysopa perla;* 2, eggs of *Chrysopa;* 3 and 4, larva; 5 and 6, cocoon, nat. size and magnified.

Larvæ with six legs; pupæ various, in *some cases active*, and somewhat resembling the perfect insect; in others *inactive*, with the limbs folded beneath them.

The families of the Dragon-flies (*Libellulidæ*), Stone-flies (*Perlidæ*), and May-flies (*Ephemeridæ*), pass their first stages in the water, and have *active* pupæ as well as larvæ.

Hemerobiidæ (see *C. perla*, figured above) are peculiar in laying eggs fixed by a long stalk of a viscid secretion; the larvæ feed ravenously on Aphides. In the eleven families of which *Neuroptera* is composed, it is said that there is "scarcely a leading characteristic of the Order which does not meet with an exception."

6. TRICHOPTERA (Kirby).—Caddice-flies.



Mormonia nigromaculata, Caddice Fly, magnified; lines showing nat. size.

Wings four, membranous, the upper usually with branching nerves, and "*hairy*"; the under pair shorter and broader,

and folded when at rest; legs long; jaw rudimentary. The early stages are passed in water. The larvæ (known as Cadbaits or Caddice-worms) are nearly cylindrical, with six legs, and live in cases which they form themselves of little bits of stick, or pebbles, shells, &c.; and in these they change (in the water) to pupæ much resembling the perfect insects.

7. HYMENOPTERA (Linnæus).
Wasps, Bees, Sawflies, Gall-flies, &c.

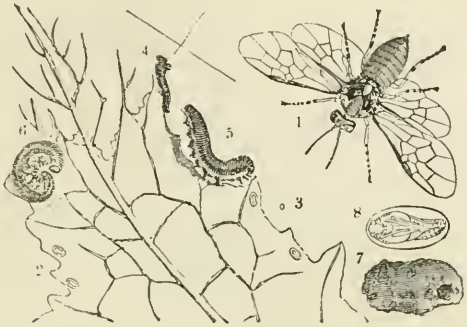
Humble Bees: 1, *Bombus lucorum;* 4, *B. terrestris.*

Wings four, naked, "*membranous,*" and furnished with a few veins; the upper pair (which are much larger than the under ones) are marked on the fore edge with a minute thickened spot called the "*stigma.*" The head is usually furnished with large compound eyes, and also with three simple eyes or "*ocelli*" on the crown; the horns are various (sometimes in the Sawflies with fine comb-like processes). The upper jaws (mandibles) are horny, but not always serviceable for eating with; and in some cases, as with the Honey Bees, a portion of the mouth apparatus (the maxillæ), united with the lower lip and its appendages, form a sucker or proboscis by means of which to draw up food. The body is covered with a hard skin, and usually has head, thorax, and abdomen distinctly s parated.

The abdomen of the female is often supplied with a sting, or with an ovipositor, by means of which she can pierce into animal or vegetable matter to insert her eggs. In some cases this is done by means of a kind of borer; in some, as with the "Saw"-flies, by means of a kind of saw-like apparatus.

The larvæ are usually maggot-like and footless, with the mouth commonly but slightly developed; but in the family of

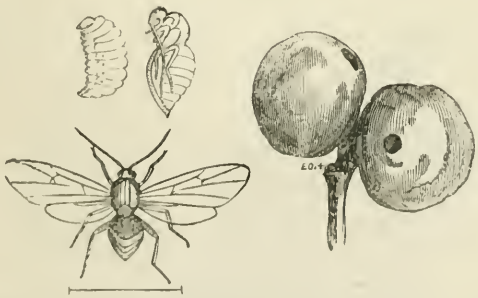
the Sawflies (*Tenthredinidæ*) the larvæ are more like Butterfly-caterpillars, and have usually, besides the six true feet, twelve to sixteen sucker-feet. (The Corn Sawfly, see p. 94, is an exception, being footless.)



Turnip Sawfly (*Athalia spinarum*): caterpillars, pupa, and pupa-case. Sawfly, magnified, with lines showing nat. size.

Pupæ are *inactive*, with the limbs of the future insect distinguishable, but wrapped in sheaths and folded beneath the breast. Change sometimes takes place in cocoons.

This Order contains the families of Sawflies (*Tenthredinidæ*), Sirices (*Uroceridæ*), Gall-flies (*Cynipidæ*), Ichneumon-flies (*Ichneumonidæ*) (and other kinds of Parasite-flies), Ants (*Formicidæ*), Wasps (*Vespidæ*), and various kinds of Bees (*Andrenidæ* and *Apidæ*), classed under the head *Mellifera*.



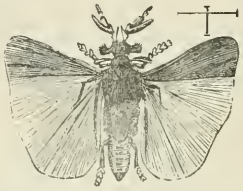
Marble-Gall Fly (*Cynips kollari*), magnified, with line showing expanse of wing; larva and pupa.

For examples, see Oak-Gall Fly, Sawflies of various kinds, and Sirex.

The Order of *Hymenoptera* is remarkable (and exceptional) for the large number of sucker-feet usually possessed by the larvæ of the family of the *Tenthredinidæ*, which are sometimes

known as "false caterpillars" from their great resemblance to thet rue caterpillars of Moths and Butterflies. Various kinds of these "Sawfly" caterpillars are excessively injurious to leafage.

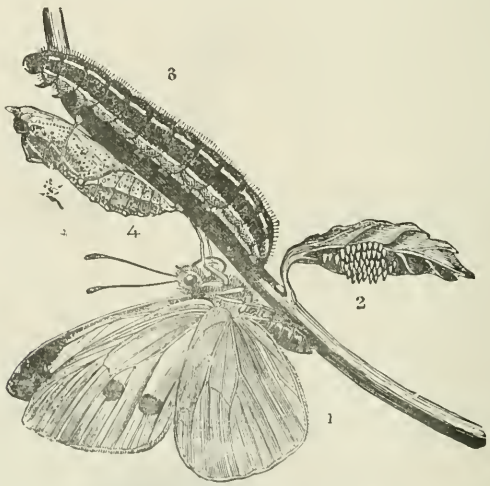
8. STREPSIPTERA (Kirby).—Bee Parasites.



Bee Parasite (*Stylops spencii*), magnified, with lines showing nat. size. After figure by J. O. Westwood.

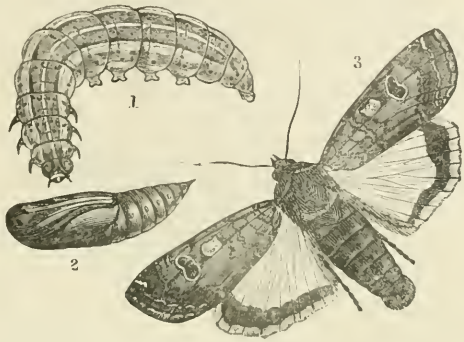
These are named from the small "twisted" appendages which they bear in the place of the fore wings; the true wings are large in proportion to the size of the insect, forming more than a quarter of a circle, with the two straight edges placed in front and against the body. They live in the larval state as parasites in Wasps and Bees, and merely require to be referred to here.

9. LEPIDOPTERA (Linnæus).—Butterflies and Moths.



Large White Cabbage Butterfly (*Pieris brassicæ*): 1, female Butterfly; 2, eggs 3, caterpillar; 4, chrysalis.

Wings four, covered on both sides with fine "*scales*" (whence the name of *Lepidoptera*, from *Lepis*, a scale). Head furnished with two large compound eyes, and sometimes with *ocelli;* horns various; mouth with a proboscis. Body hairy, or scaly.



Yellow Underwing (*Tryphæna pronuba*): 1, caterpillar; 2, pupa or "chrysalis"; 3, Moth.

The larvæ, commonly called caterpillars, are nearly cylindrical, long, soft, and often variously coloured, spined, or tubercled; the head is scaly or horny, bearing eyes, jaws, and a pair of short horns; the three segments next to the head have usually a pair of horny feet on each, and of the remaining nine segments the tail and the *four* intermediate ones are usually each furnished with a pair of sucker-feet or *pro-legs*. These vary in number from four to ten, but the pair beneath the tail is seldom missing. The caterpillar when about to change usually spins a cocoon with thread from its mouth, or buries itself, or in some way provides a place of safety; it

Large Cabbage Butterfly.

then moults its skin for the last time, and a viscid moisture exuding from the surface of the newly-exposed chrysalis

hardens rapidly over the rudimentary limbs of the future Moth or Butterfly, and protects it in its *inactive* state, till in due time this outer case is cracked down the back and the insect comes forth.

This Order is divided into Butterflies and Moths; the Butterflies are distinguishable by their horns being almost invariably thin and long, ending in a knob (see fig. p. 389); also by their light and elegant shape, and beautiful colouring. They mostly fly by day, and when at rest carry their wings erect.

Lobster Moth (*Stauropus fagi*), male.

The Moths are distinguishable by the horns *never* being club-shaped, but generally thread-like or with side branches; and they commonly rest with their wings expanded, and are of a heavier make and more sluggish in flight than the Butterflies; also, though not exclusively evening or night-fliers, many of them are so.

The family of the Clearwing Moths (*Sesiidæ*) is very peculiar, and differs from the other *Lepidoptera* in the wings being more or less transparent or "*clear*," and *without* "*scales*"; but from other characteristics resembling those of this Order it has been placed in it.

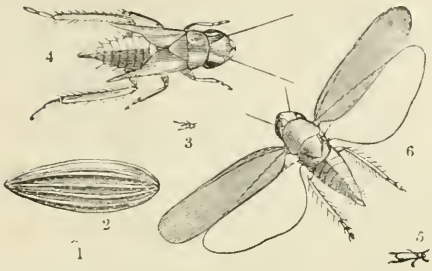
Currant Clearwing (*Sesia tipuliformis*).

The larvæ of the Clearwings feed and change to chrysalids in branches or roots of trees.

For examples of Butterflies, see Cabbage Butterflies; of Moths, see those of Cabbage, Turnip, Apple, &c.

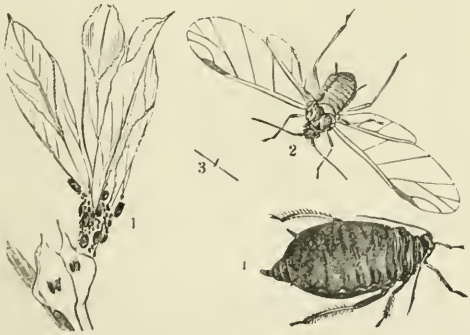
10. HOMOPTERA (MacLeay).

Froghoppers, Aphides, or Green Fly, Scale Insects, &c.*



Potato Frog-fly: 1 and 2, eggs; 3 and 4, pupa; 5 and 6, Frog-fly, nat. size and magnified.

Wings usually four (but sometimes two, or absent), entirely membranous, slanting downwards, the upper largest, and not overlapping when at rest. Head with a mouth formed for suction and placed far back beneath it. Horns often short. Larvæ various; pupæ usually active.



Bean Aphis: 1, Bean-shoot with Aphides; 2, male, mag.; 3, nat. size; 4, wingless female, magnified.

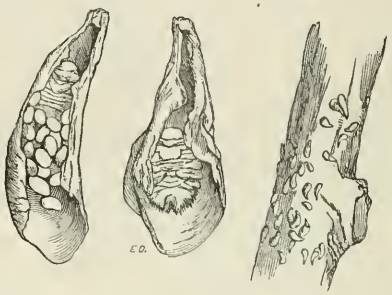
This Order contains such various forms of insects that it is convenient to take the sub-division, as given by Prof. Westwood, into three sections, of *Trimera*, *Dimera*, and *Monomera*, having respectively three, two, and one, joints in the feet.

The first includes many large foreign insects, as Lanthorn

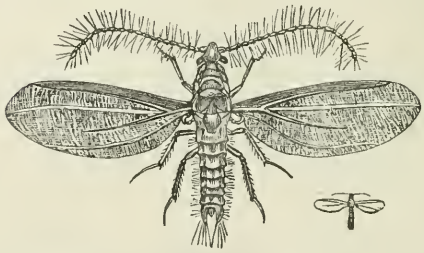
* The insects included in this and in the following Order by Prof. Westwood, are included at the present day in the Order Hemiptera (or Rhynchota of Burmeister), and classed respectively under the Sub-orders of Hemiptera, Heteroptera, and Hemiptera-Homoptera. I have retained the distinction as given by Prof. Westwood, as the separation of these divisions seems to me to make the subject clearer.

Flies, &c.; and amongst our own the Cuckoo-spit, or Froth-fly, *Tettigonia spumaria*, and the Froghoppers (see pp. 171, 391).

The second section includes the *Aphides*, or Green Fly, of which the Bean Aphis is figured at p. 391. *Psyllidæ*, or Jumping Plant-lice; and *Aleyrodes*, or Snowy-flies.



Apple Mussel Scale: female and eggs, magnified. Twig with Scale, nat. size.



Male of "Cottony Cushion Scale" (*Icerya purchasi*), nat. size and mag. (After Prof. Riley).

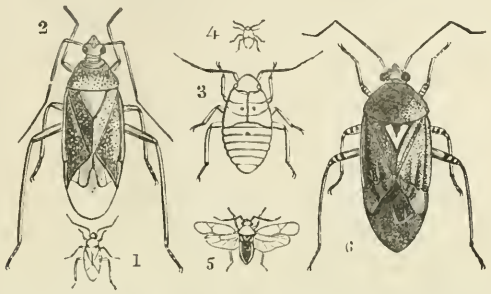
The third section is of the *Coccidæ*, or Scale Insects; here the females are usually fleshy masses, furnished with suckers, but without trace of articulated limbs; the males have one pair of wings, but the mouth is obsolete.

For descriptions and life-histories of the above insects, see references in Index, and for history of *Icerya purchasi*, see 'Observations on some Injurious Insects of S. Africa,' by Ed.

11. HETEROPTERA (Westwood).
Plant Bugs, Water Scorpions, &c.

Wings four, the upper pair or wing-cases the largest, partly lapping over each other when at rest, and with the part the nearest to the body leathery and "*dissimilar*" in texture to the rest of the wing, which is membranous; under wings membranous, sometimes wanting.

The head is usually broad, with horns commonly of moderate length, composed of three to five joints; mouth suctorial, but placed *in front* of the lower part of the head.



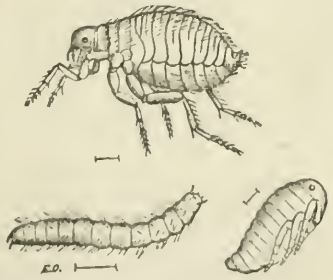
1 and 2, Potato Bug (*Lygus solani*): 3 and 4, pupa, nat. size and magnified; 5, Hop Bug, nat. size; 6, ditto, magnified.

Horns usually somewhat thread-like. Legs various, chiefly formed for walking, but sometimes in the aquatic species with fringes on the hinder pair.

Larvæ resemble the perfect insect, but without rudiments of wings; pupæ with still more resemblance, from these being distinguishable.

One section of this Order lives in water, and contains the insects commonly known as Water Scorpions and Water Boatmen; the other, besides the "Water Measurers" common *on* water, contains various kinds of Bugs preying on plant and animal life by means of their suckers, and characterised generally by a power of giving out a scent on being alarmed, which is usually, but not always, of a disagreeable kind.

12. APHANIPTERA (Kirby).—Fleas.



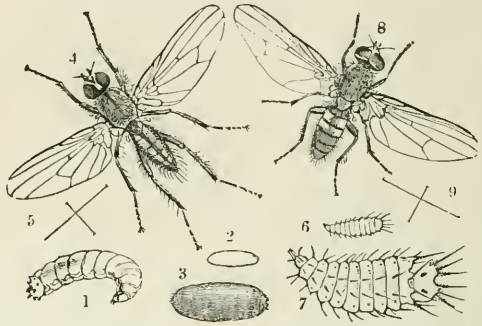
Flea, maggot, and pupa, magnified; lines giving nat. length.

Four scales, which are "*imperceptible*" to the naked eye,

take the place of wings. The legs are long and formed for leaping, and the mouth for suction.

The larvæ are minute worm-like, footless grubs; the pupæ are inactive, with legs enclosed in sheaths.

13. DIPTERA (Aristotle).—Flies.



Various kinds of dipterous Flies (see pp. 31—34): 1, 6, and 7, larvæ; 2 and 3, pupæ, nat. size and magnified; 4, 5, 8, and 9, Flies, magnified, with lines showing nat. size.

Wings "*two*," membranous; in the place usually occupied by the hind wings are a pair of slender filaments with a knob at the end, called "poisers" or "*halteres*." Head usually distinct, and horns generally inserted near together on the forehead. Mouth formed for suction. Legs long.

Daddy Longlegs (*Tipula oleracea*), eggs, grub, and chrysalis.

The grubs are fleshy and (with few exceptions) footless;* sometimes, like the Daddy Longlegs grub, they have a hard head, furnished with nippers or jaws; but often they are cylindrical as figured, truncate at the tail, and elongated at the head extremity, which contains a soft mass which answers for a head, commonly bearing a pair of hooks instead of jaws, with which they clear out the substance in which they may be feeding.

Pupæ various; in most cases the skin of the larva shrinks and hardens, so as to form an oval or cylindrical case in which the change takes place, and out of which Fly-case the Fly makes its way when developed; but in some instances, as of the Daddy Longlegs, figured p. 394, and some others, is in shape much like the creature within, with its limbs folded.

The family of the Æstridæ, which includes the well-known Ox Warble Fly, Horse Bot Fly, and the Sheep's Nostril Fly, is parasitic in different parts of animals; for special details of life-history and means of prevention of the first-named, see publications by Ed.

2 1 3

1, Ox Warble Fly; 2, maggot; 3, chrysalis.

Ostrich Fly (*Hippobosca struthionis*) and egg-like pupa-case, nat. size and mag.; foot and claw magnified.

In the family of the Hippoboscidæ, of which some are known as "Forest-flies," the insect passes the larval stage and

* The maggots of two kinds of Flies (*Eristalis* and *Helophilus*) are peculiar for possessing seven pairs of what may be called a kind of claw-like feet. These maggots are known as "rat-tailed larvæ," from the hinder part of the body being lengthened into a long slender tail-like tube, whereby they can draw in air from above the damp or muddy places in which the maggots lie.

changes to the pupa in the abdomen of the female before being deposited.

The figure, p. 395, was taken from specimens forwarded to me from S. Africa, by Mr. Bairstow, of Port Elizabeth, as being injurious to Ostriches, and on examination for me by M. Bigot (Paris), the well-knowndipterist, they were conside red by him to be of a previously undescribed species.

GLOSSARY.

Alæ.—Wings.
Alate.—Winged.
Alula.—Small membranous appendage to the base of the hinder edge of the wings of *Diptera* (two-winged flies).
Antennæ.—"Horns" or "cranial feelers" placed in front of the head; various in form, sometimes thread-like, and longer than the insect; elbowed; with a club of leaves; also saw-like, feathery, and many other forms; in butterflies somewhat like pins.
Apterous.—Without wings.
Cauda.—Tail.
Caudal pro-legs.—Sucker-feet attached to the tail-segment of many kinds of *larvæ*.
Chrysalis.—A term applied to the pupal stage, when inactive, of various insects, chiefly butterflies and moths.
Clypeus.—Portion of the front of the face above the upper lip.
Cocoon.—A case, formed of silk or other materials, by various kinds of *larvæ*, commonly for protection whilst they change to *pupæ*.
Coxa.—The hip; the first chief division of the legs of perfect insects, between the *thorax* and the thigh or *femur*.
Elytra.—Horny wing-cases—term commonly applied to the upper wings of beetles.
Eyes, compound.—The common form placed on each side of the head, and composed of a large number of separate eyes or lenses placed side by side.
Eyes, simple.—Ocelli; minute single eyes placed on the crown of the head.
Feelers.—Palpi; small appendages on the lower jaws and lower lip.
Femur, plural *Femora.*—Thigh; second chief division of the leg.
Halteres.—Poisers; short appendages, often club-like, or like slender pins, to be found in two-winged flies, taking place of the absent hind wings.
Haustellum.—Term applied to different kinds of insect-mouths formed for suction.
Horns.—Antennæ; organs of various shape placed on front of head.
Imago.—Insect in perfectly-developed stage, as butterfly, fly, beetle, &c.
Labium.—Lower lip.
Labrum.—Upper lip; this is placed vertically over the lower lip, with the two pairs of jaws placed horizontally between the two lips.
Larva.—First active stage of insect-life, as caterpillar, maggot, &c.
Legs.—In the perfect insect, formed of four chief pieces,—hip (*coxa*), thigh (*femur*), shank (*tibia*), and foot (*tarsus*),—with a small piece, called the trochanter, between the hip and thigh. In larvæ, short legs of various forms, and sucker feet, or pro-legs.
Mandibles.—Upper jaws, placed horizontally opposite each other beneath the upper lip.
Maxillæ.—Lower jaws, placed similarly to the above, just below the "mandibles," and furnished with feelers; thence called feeler-jaws.
Maxillary palpi.—Feelers on the lower jaws.

Mouth.—Formed of six pieces, an upper lip (*labrum*), lower lip (*labium*), with two pairs of jaws opposed horizontally between them, of which the upper pair (mandibles) are often strong, and serve for biting with; the lower pair (*maxillæ*, or feeler-jaws) are usually smaller, and weaker, and are furnished with feelers or *palpi*, as is also the *labium*. In butterflies, Aphides, &c., that have sucker-mouths, some of the above-mentioned portions are variously altered in shape.—See *Proboscis*.

Ocelli.—Minute single eyes, usually three in number, fixed on the crown of the head, commonly known as simple eyes.

Oviparous.—Producing eggs.

Ovipositor.—Instrument whereby the female insect lays her eggs.

Ovum.—Egg.

Palpi.—Feelers, placed on the lower jaws and lower lip.

Poisers (see *Halteres*).—Appendages in the place of the hinder wings of the Diptera.

Proboscis.—In butterflies, altered lower jaws forming the spiral trunk; in two-winged flies, the altered lower lip enclosing the piercers.

Pro-legs.—Sucker-feet, whereby caterpillars and other larvæ hold firmly to the substance they are placed on.

Pulvilli.—Cushions beneath the feet of flies and some other insects.

Pupa.—Second stage of insect-life, in which it is inactive, as with the chrysalis of butterflies, in some Orders; and active and much resembling the parent, excepting in the organs of flight not being developed, in other Orders, as with grasshoppers.

Rostrum.—Sometimes called snout, when applied to the prolonged front of the head of some kinds of beetles; also used as well as proboscis for the altered *labium* of Aphides.

Scutellum.—A name sometimes applied to a portion of each segment of the *thorax*, but especially to the triangular shield-shaped plate between the base of the wing-cases in beetles and bugs.

Segments.—Rings of which an insect is composed—considered to be thirteen, including the head.

Spiracles.—Breathing-pores, for the most part placed along sides of insects, or at the end of the tail, by means of which the air is drawn into or expelled from the *tracheæ*, or breathing-tubes.

Stigma.—A small thickened spot on the front edge of the fore wing of various kinds of insects.

Sucker-feet.—Pro-legs; fleshy appendages whereby larvæ hold firmly to the twigs, &c., whereon they are placed.

Tarsi.—Feet, the fourth chief division of the leg, being that on which the insect rests, and composed of a variable number of joints, up to five.

Telum.—Last segment of the abdomen.

Thorax.—The three segments next to the head, known respectively as the pro-, meso-, and meta-thorax, of which in perfect insects the foremost, or pro-thorax, bears a pair of legs, the other two each a pair of legs and wings.

Tibia.—Shank; third chief division of the leg between the thigh (*femur*) and foot (*tarsus*).

Tracheæ.—Organs of respiration communicating with the air by breathing-pores (*spiracles*) in the sides of the insect, and conveying it by means of smaller tubes throughout the body.

Ungues.—Claws or curved hooks at the extremity of the foot.

Viviparous.—Producing living young.

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In the First Edition of this volume the names of those to whom I was mainly indebted for special information were noted by initials appended to their contributions; the names are now given in full in the following list.

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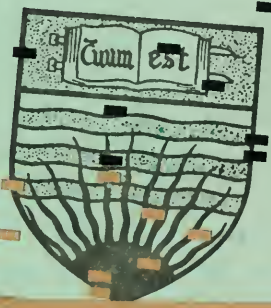

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